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ABSTRACT

This report examines research on initiatives intended to restructure military training with a focus on specialized skill training in military schools. Chapter 1 addresses the status of restructuring initiatives. Chapter 2 focuses on a methodology to examine the effects of restructuring and consolidation. It discusses in detail the elements included in the methodology that accomplish the following: match occupations to training approaches; develop alternative courses based on job requirements; assess costs and savings of alternative courses; and conduct clinical trials to confirm effectiveness. Chapter 3 discusses the research context, approach, and results of studies examining these restructuring and consolidation initiatives: distributed training programs; consolidated occupations with expanded on-the-job training; use of civilian resources to provide military training; expanded use of training aids, devices, simulators, and simulations more extensively to substitute for vehicles, equipment, and live-fire training; and consolidation of training institutions. Chapter 4 synthesizes those findings into a series of implications for effectively and efficiently employing restructuring initiatives. Key issues are categorized as consolidation, distribution, outsourcing, and training technology. Appendixes include a brief discussion of some military lessons learned that seem transferable to the civilian sector and 56-item selected bibliography. (YLB)

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Restructuring Military Education and Training

Lessons from RAND Research

John D. Winkler

Paul S. Steinberg

Prepared for the United States Army

Arroyo Center

RAND

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PREFACE

This report aims to identify promising directions for restructuring programs of military education and training to make them more effective, affordable, and efficient. The document is motivated in part by the Department of Defense's Quadrennial Defense Review, which is examining ways to modernize and improve all DoD programs in light of the sweeping changes that have occurred in the past several years. The report summarizes results and insights from a number of RAND studies that assessed alternative concepts for restructuring military training programs within and across the military services. Most of the research discussed within comes from work conducted in RAND's Arroyo Center, the Army's federally funded research and development center (FFRDC) for studies and analysis. However, where appropriate, the report draws upon research conducted in RAND's two other military FFRDCs—the National Defense Research Institute (NDRI), which serves the Office of the Secretary of Defense (OSD), the Joint Chiefs of Staff, and the defense agencies; and Project AIR FORCE, which serves the Air Force.

The following RAND publications were drawn upon in this document and are shown in the order discussed in the text:

- DB-144-A, *Improving Training at School and Work: Lessons from RAND Research on Army Individual Training*, John D. Winkler, 1995.
- R-4228-A, *Linking Future Training Concepts to Army Individual Training Programs*, John D. Winkler, Stephen J. Kirin, and John S. Uebersax, 1992.

- N-3527-A, *The Army Military Occupational Specialty Database*, Stephen J. Kirin and John D. Winkler, 1992.
- MR-120-A, *Computer-Based Training of Cannon Fire Direction Specialists*, Hilary Farris, William L. Spencer, John D. Winkler, and James P. Kahan, 1993.
- R-4224-A, *How to Estimate the Cost of Changes in Army Individual Skill Training*, Susan Way-Smith, 1993.
- MR-118-A, *Distributed Training of Armor Officers*, John D. Winkler, Susan Way-Smith, Gary Moody, Hilary Farris, James P. Kahan, and Charles Donnell, 1993.
- R-4242-A, *Design of Field-Based Crosstraining Programs and Implications for Readiness*, William G. Wild, Jr., and Bruce Orvis, 1993.
- R-4119-FMP, *Who Should Train? Substituting Civilian-Provided Training for Military Training*, Lawrence M. Hanser, Joyce N. Davidson, and Cathleen Stasz, 1991.
- MR-119-A, *Device-Based Training of Armor Crewmen*, Gary Moody, Susan Way-Smith, Hilary Farris, John D. Winkler, James P. Kahan, and Charles Donnell, 1993.
- R-3848-FMP, *Effectiveness of Interactive Videodisc in Army Communications Training*, John D. Winkler and J. Michael Polich, 1990.
- R-4156-A, *Simulation Support of Large-Scale Exercises: A REFORGER Case Study*, Patrick D. Allen, 1992.
- N-3152-A, *Observations of the Caravan Guard 89 Exercise*, Patrick D. Allen et al., 1992.
- MR-844-A, *Resources, Cost, and Efficiency of Training in the Total Army School System*, Michael Shanley, John D. Winkler, and Paul Steinberg, 1997.

The research reported here was conducted in the Arroyo Center's Manpower and Training Program with partial funding from RAND. The results described in this report should be of interest to policymakers concerned with education and training and to managers responsible for designing and implementing training programs in both military and civilian settings.

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SUMMARY

As the military becomes smaller and defense budgets shrink, pressures grow to justify and reduce training costs, which total billions of dollars annually. In response, the Department of Defense and the military services are actively exploring ways to lower the costs of military training. But because maintaining preparedness remains a high priority, the military cannot afford wholesale or indiscriminate reductions in training activities and resources. Thus, the problem the military faces is how to reorganize its training functions to reduce costs while preserving effectiveness.

This report, by drawing on the findings of numerous RAND studies of military education and training conducted over the last two decades, identifies tools and provides insights for making training more efficient and affordable. It draws its findings largely from studies that address *individual military education and training*, which provides soldiers with the specialized skills and knowledge they need to perform their functions as members of military organizations. However, we also address the implications of this research for other types of training (e.g., collective training in units) and for functions related to individual training that are customarily not analyzed (e.g., training development and support).

A FRAMEWORK FOR TRAINING

The research reviewed for this study primarily addresses four ways to restructure training to make it better, cheaper, or both. These are consolidation, outsourcing, distribution, and use of technology. A useful way of thinking about these approaches is to consider how

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they affect training and resources in a way that will highlight the areas likely to yield the most significant efficiencies or savings. Training resources are of three types: manpower, equipment, and facilities. Similarly, training itself consists of three major activities: development, delivery, and support. The document discusses how the four techniques affect resources in the three major training activities.

INSIGHTS GAINED FROM RAND RESEARCH

The research reviewed for this study stretches over a number of years and addresses different training courses and techniques. Although the specific projects deal with individual courses or technologies, we have attempted here to broaden the insights so that, as policymakers consider ways to reduce the cost of training or improve its efficiency, they can serve as guideposts.

Consolidating Training

The research surveyed two types of consolidation: one consolidates training institutions, while the other consolidates military occupations.

Consolidation of training institutions. A set of RAND studies examined consolidation of institutions and courses. One study considered options for consolidating schools that provide individual training to the Army's Reserve Components. The perception was that too many courses were offered at too many locations and that consolidation could yield substantial savings. Redundancy is a primary characteristic that makes centralized training a good idea; however, only so much consolidation proves beneficial. Reducing the number of training sites too much can drive up the transportation and temporary duty (TDY) costs so far that they offset any savings garnered. The research shows that consolidation is most efficient when support costs are very high, such as they are for combat arms courses. For one type of infantry training for National Guard soldiers, the data show that four training sites offer the maximum savings (compared with the eight that were being considered). The opposite conclusion holds for courses whose support costs are low (e.g., personnel ad-

ministration and most weekend drill training). In these cases, multiple locations may be the low-cost option.

Consolidating occupations and expanding on-the-job (OJT) training. Another study considered an approach called "field-based cross training," which involves consolidating military occupations and shifting some training to formal OJT programs. It considered consolidating 13 aviation mechanic specialties and transferring the training of specific skills to the units. The results show that consolidating specialties does reduce backlogs because more people are available to work on jobs, but that the greatest benefits occur in the first few consolidations, with sharply diminishing benefits after those. Put another way, not everyone needs to know how to do everything. Selected consolidation offers the best approach for reductions while maintaining capabilities.

Regarding the OJT portion of the study, three aspects prove to be especially important: where the individuals are placed, the source of the work, and how much training is shifted. For the aviation maintenance skills studied, OJT appears feasible because the type of work at different echelons is similar, and the skill a trainee develops at one level can transfer to another. However, centralizing OJT at the intermediate maintenance level can result in an unacceptable loss in experience level. The only viable source of OJT workload appears to be that which occurs normally; using other than normal work hours for OJT appears to be infeasible because of a high number of competing requirements. Finally, in terms of the amount of training shifted, it does not seem likely that task training can be shifted to a field location because the workload is insufficient to teach trainees difficult tasks. Thus, though reducing the length of advanced training offers benefits, the added burden on field units and the potential for loss of skills offset the benefits.

Outsourcing Training

Outsourcing or using civilian contractors to provide services has received considerable attention because of the potential cost savings this approach offers. A RAND study analyzed the issues associated with using civilian-based instruction to provide initial skill training, to include providing that training before an individual joins the service. This latter option may be attractive because it may be possible

to reduce the time and costs of formal training. Of course, if accession is delayed significantly, skills may decay, necessitating retraining and canceling any savings. The study found that almost no programs had been systematically evaluated and that there was a dearth of data about the cost or quality of the training. Thus, the metrics needed to evaluate civilian-based options were absent. That lack of information notwithstanding, a number of military occupations seem amenable to outsourcing, and, indeed, several contract courses exist in the Army and the Navy. There may also be room to expand outsourcing of training development and training support (e.g., school administrative functions). Expanding contract instruction, capitalizing more extensively on civilian education and training, and outsourcing training development and support are complex questions requiring more detailed research.

Distributing Training

One potential way to reduce training costs is to rely less on large, centralized courses and distribute the training so that some of it is done at home station, thus shortening the time students must remain at the centralized site and possibly reducing the faculty there as well. One study examined the Armor Officers' Advanced Course to determine how much of the 20-week program could be accomplished elsewhere. Research results show that far less than the hoped-for 60 percent (12 weeks) could be done through distributed training methods. The analysis suggested that only about 4 weeks could be accomplished in this fashion. When compared with two other training courses, the Armor Officers' course offers the most potential for distributing training. This inability to distribute training suggests that, at least for these courses, a good match exists between schoolhouse instruction and job requirements.

The analysis also shows that the cost of distributing training depends importantly on the details of how the training is distributed. Three factors have the most influence: the extent to which existing facilities can be used, how manpower is handled, and the mix of instructional media. If existing facilities can be used, distributed training can provide significant savings and quick payback. Under this assumption, the training that could be distributed for the Armor Officers' course resulted in one-time cost of close to $2 million but paid back

$8 million over five years, with a one-year break-even point. However, new facilities drive the cost up to over $7 million and drag the break-even point out to nine years. Concerning manpower, if the changes increase it at the distributed site, the increase offsets any savings at the centralized location, and no real savings occur if end strength does not decrease. Finally, the instructional media can strongly influence cost. Generally, as the media get more technologically complex, the costs increase and payback periods lengthen.

Expanding the Use of Training Technologies

RAND studies have investigated the use of training technologies, including what are called TADSS (for training aids, devices, simulators, and simulations) and interactive computer-based systems. A set of studies examined the use of three types of TADSS: device-based training for armor crewmen, interactive videodiscs for communication training, and simulations for collective training.

The study examining device-based training for armor crewmen showed that a substantial number of tasks currently taught with equipment could be effectively taught with TADSS. A tank is an expensive training device. Using a range of assumptions, the analysis showed that considerable savings would occur. Most savings result from reduced costs for fuel, spare parts, and maintenance. However, the cost savings are driven by how the devices were obtained. If they were developed from scratch, the one-time costs exceeded the five-year savings. However, local equipment could be modified—tanks in the installation inventory converted to turret trainers and hull driver training vehicles—and return $38 million in savings for a $5 million investment.

A second study investigated the use of interactive videodisc (IVD) in communications training. It examined the use of IVD both to increase proficiency and to substitute for actual equipment. The results show that the increases in proficiency were only modest, suggesting that the additional opportunities for practice provided by the IVD were probably unnecessary. That is, the students were learning the tasks well under the old system. Thus, any effort to add training technology to improve proficiency must take the initial proficiency level into account. Substitution of IVD for actual equipment showed

more promising results. The students who trained on the IVD did as well as those who trained on actual equipment.

A final study examined the use of simulations in conjunction with collective training exercises. Full-blown field training exercises are expensive and, as access to maneuver terrain becomes more problematic, increasingly difficult to conduct. The study looked at the use of computer-assisted exercises at different levels during a corps exercise. The results provide strong evidence that simulations can be effective for conducting collective training at all levels. In fact, for certain functional areas (e.g., deep attack), simulations may provide better training than traditional exercises. However, the technical quality of the simulations examined needs improvement.

IMPLICATIONS

The research reviewed for this study shows that **consolidation** can lead to more effective and efficient training. Given the substantial amount of training the military conducts, there should be numerous opportunities to combine schools, reduce training locations, and share facilities. The key is to pursue those that offer the most cost savings or greatest efficiency gains. Two signal characteristics can help identify such opportunities. The first is the amount of overlap. Courses or institutions with high commonality can yield high savings and short payback periods. The second characteristic is the use of high-cost resources. The amount of savings will be limited by the amount of resources used. So in seeking candidates for consolidation the military should first look to large courses and institutions that teach the same thing. However, it must be careful not to consolidate too far and cause ancillary costs such as transportation and TDY nullify any savings.

Turning to **distribution**, it may be possible to save money or improve efficiency by distributing training, but the lessons of the studies reviewed here suggest caution. Moving the training must result in reductions or eliminations, not simply shifting personnel from one place to another. Furthermore, careful analysis of facilities and training media is necessary to ensure that their startup and recurring costs do not overwhelm any savings. Distribution is most likely to succeed where doctrine and tasks are likely to remain stable. Change

across a distributed training base is probably going to cost more than change in a centralized one.

Outsourcing is currently fashionable, and some situations seem to have potential for savings and efficiencies. However, as with distributed training, savings will accrue only if reductions occur. The use of outsourcing for training or support requires more intensive study to determine the likely benefits.

Training technology clearly has a role. Based on the studies reviewed here, it appears more likely to be beneficial when used to substitute for other resources to reduce operating costs. Also, it can reduce personnel pay and allowances by reducing time needed to train (e.g., through faster pacing of instruction). If improved proficiency is the goal, the level of skill achieved by current methods requires careful assessment. Marginal skill improvement may not justify the expense. The best approach for using training technologies may be in conjunction with a detailed assessment of the current process to determine if it should be changed and then an analysis to ascertain where technology might make the best contribution.

AC	Active Component
AGC	Automatic Gain Control
AIT	Advanced Individual Training
AMI	Apprentice Mechanic Initiative
AOAC	Armor Officers' Advanced Course
AOSP	Armor Occupational Survey Program
ARNG	U.S. Army National Guard
AT	Annual Training
ATC	Air Training Command
AVIM	Aviation Intermediate Maintenance
AVUM	Aviation Unit Maintenance
BCTP	Battle Command Training Program
CAX	Computer-Assisted Exercise
CBS	Corps Battle Simulation
CBT	Computer-Based Training
CFX	Command Field Exercise
CNET	Chief of Naval Education and Training
CNTECHTRA	Chief of Naval Technical Training

CPX	Command Post Exercise
DoD	Department of Defense
EW	Electronic Warfare
FBCT	Field-Based Crosstraining
FTX	Field Training Exercise
IF	Intermediate Frequency
IST	Initial Skill Training
ITRO	Interservice Training Organization
IVD	Interactive Videodisc
MMTR	*Military Manpower Training Report*
MOS	Military Occupational Specialty
MOS-D	Military Occupational Specialty Database
MTSR	Military Training Structure Review
NCO	Noncommissioned Officer
OJT	On-the-Job Training
O&M	Operations and Maintenance
OSUT	One-Station Unit Training
POI	Program of Instruction
RC	Reserve Components
RCTI	Reserve Component Training Institution
REFORGER	Return of Forces to Germany
SL	Skill Level
SME	Subject Matter Expert
TADSS	Training Aids, Devices, Simulators, and Simulations
TASS	Total Army School System
TDY	Temporary Duty

TMY	Trained Man-Years
TRADOC	U.S. Army Training and Doctrine Command
TROPO	Tropospheric Scatter
USAR	U.S. Army Reserve
WPC	Warrior Preparation Center

Chapter One

INTRODUCTION

BACKGROUND

The Need to Reduce Costs and Maintain Effectiveness of Military Training

Military training is an extensive, resource-intensive activity, using considerable manpower, equipment, consumables, facilities, and installations. In recent years, for example, funds required to conduct training in military training institutions totaled about $14 billion annually, according to the Department of Defense's annual report to Congress, the *Military Manpower Training Report (MMTR)*.[1] These costs include funding for military pay and allowances for training manpower and trainees, training-related expenses, support personnel, construction and procurement costs, and overhead.

But this accounting is not entirely complete. The *MMTR* addresses education and training of Active Force members and Reserve Component (RC) members on active duty in formal school courses at Active Component (AC) training institutions. It covers Major Defense Program VIII (P8) funds, which are used for a number of purposes, including basic training, specialized skill (occupational) training, officer precommissioning training, and advanced professional development.[2] These funds, however, do not include ex-

[1]Office of the Assistant Secretary of Defense (Force Management and Personnel), *Military Manpower Training Report FY 1997*, June 1996.

[2]Flight training and one-station unit training are additional types of recruit and specialized skill training covered by P8 funds.

penses for RC trainees in RC training institutions (e.g., National Guard State Military Academies) or civilian programs (e.g., ROTC). Moreover, P8 funds do not include costs that support training and activities (e.g., base operations, direct support, real property maintenance).

And considerably more resources are required to support collective training in operational units at schools, combat training centers, maneuver areas, and ranges; in fact, since training is one of the military services' primary peacetime activities, it represents a key use of the services' operations and maintenance (O&M) funding.

As the military becomes smaller and defense budgets shrink, pressure grows to justify and reduce the costs of training, which is leading the services to modify customary methods of training. But as long as maintaining readiness and preparedness remains a high priority, the military cannot afford wholesale or indiscriminate reductions in training activities and resources. Thus, the fundamental problem facing the military is how to reorganize the training function to reduce costs while preserving quality and maintaining effectiveness.

Current Restructuring Initiatives

With pressures on training budgets continuing to grow, the DoD and the military services have actively explored ways to restructure training functions within their various agencies responsible for training, including respective headquarters,[3] training commands,[4] and major unit commands. These include initiatives that consolidate training functions and activities, both within each respective

[3]These include the Office of the Under Secretary of Defense (Personnel and Readiness) and the principal staff officer within each service headquarters (i.e., for the Army, the Director of Training in the Office of the Deputy Chief of Staff for Operations and Plans; for the Navy, the Deputy Chief of Naval Operations for Manpower, Personnel, and Training; for the Marine Corps, the Deputy Commander for Training and Education of the Marine Corps Combat Development Command; and for the Air Force, the Director of Personnel Programs in the Office of the Deputy Chief of Staff for Personnel).

[4]These include the U.S. Army Training and Doctrine Command (TRADOC), Fort Monroe, Virginia; the Air Training Command (ATC) Randolph Air Force Base, Texas; the Chief of Naval Education and Training (CNET), Pensacola, Florida; and the Deputy Commander for Training and Education, Quantico, Virginia.

service and across service lines, and that cover both individual and collective training.

Intraservice initiatives for restructuring training. Many efforts devoted to restructuring and consolidating training have focused on training provided at service schools. Recent Army initiatives provide some good examples of the range of ideas under consideration that aim at maintaining the effectiveness of training while reducing operating costs, resource utilization, and manpower requirements. These include

- Reducing the number of separate military occupational specialties (MOSs) by merging occupations and combining training courses to focus on "generic" skills common to the merged occupations;
- "Distributing" training away from centralized schools to soldiers' home stations using distance learning technologies;
- Consolidating schools, while creating new "regional training sites" to replace current installations providing individual and collective training;[5]
- Using training technologies more extensively (e.g., training aids, devices, simulators, and simulations, TADSS) as partial or wholesale replacements for equipment and maneuver training;
- "Outsourcing" training by drawing on civilian training resources to deliver it.

Interservice restructuring initiatives. A commonly proposed alternative is to combine training by assigning principal or sole responsibility for a training function to one of the military services. Such proposals seem attractive because each service manages separate individual training programs containing many similar occupations and training courses. Thus, on the surface, combining or collocating courses would appear to provide economies and efficiencies.

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[5]For example, the Army is currently implementing a new system for managing and delivering training in Reserve Component Training Institutions (RCTIs) that includes mechanisms for consolidating schools, aligning training along functional lines, and specializing school missions within broad geographic areas. See Winkler et al. (199.) for a description of this program.

The Interservice Training Organization (ITRO) was created in 1972 as a voluntary, cooperative venture to facilitate such consolidations. The ITRO, with the recent inclusion of the Military Training Structure Review (MTSR),[6] provides a forum for proposing and examining the feasibility and potential efficiency of training consolidations and collocations. To date, ITRO/MTSR initiatives have focused on individual training courses conducted in military schools. ITRO has fostered a number of joint training efforts in which one military service sponsors a course that members of all military services may attend.[7]

Status of Restructuring Initiatives

In reviewing the various initiatives, we see that

- Most initiatives address individual training functions provided in institutional settings.[8] Less attention has been given to collective functions or training conducted in unit settings.[9]

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[6]The MTSR was established by the Powell Commission to conduct a "comprehensive review, with Joint Staff support, of all military skill training, specialty by specialty, to identify potential training areas for course collocations and/or consolidations" (Chairman of the Joint Chiefs of Staff, *Report on the Roles, Missions, and Functions of the Armed Forces of the United States*, February 1993, p. III-47). The MTSR was to be conducted through each service's ITRO office.

[7]A number of these initiatives are described in the *MMTR* (Office of the Assistant Secretary of Defense (Force Management and Personnel)), *Military Manpower Training Report FY 1997*, June 1996.

[8]Training that takes place in institutions occurs in formal settings conducted by organizations whose primary mission is training. These settings can include military schools and centers, as well as combat training centers, ranges, and maneuver areas. General characteristics of institutional training include fixed facilities, dedicated staff for conducting the training, and established curricula delivered in a fixed schedule under centralized control.

[9]Unit training includes activities undertaken by operational units incidental to their primary missions. Unit training addresses individual and collective tasks, depending on the unit's mission requirements and the needs of the personnel in the units. The training is managed locally using organic resources (manpower and equipment). The conditions of training may vary even between units of similar type. Unit training occurs at all levels of organization within a given echelon.

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- Existing initiatives deal primarily with training delivery activities.[10] Less thought has been given to date to restructuring of training development or support activities.[11]

Hence, the most frequently considered restructuring initiatives seek to consolidate training *delivery* functions, focusing on *individual* training conducted in *institutional* settings. This is especially true of the interservice consolidation initiatives, which seek to vest responsibility for training delivery of a given type (cooks, lawyers, etc.) with one military service.

OBJECTIVES AND SCOPE

This report examines relevant RAND research on initiatives intended to restructure military training. Its focus is on specialized skill training in military schoolhouses, which imparts skills and knowledge needed in specific jobs to officers and enlisted personnel, and is where most of the attention in this area has been placed.[12] Although the studies have centered on Army schools and courses, many of the insights should also apply to programs conducted by the other military services when those programs may be considered for intraservice or interservice restructuring or consolidation. Also, while recognizing that military and civilian training differ in a number of ways, the report briefly discusses in an appendix some of the military lessons learned that seem transferable to the civilian sector.

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[10] *Training delivery* involves all activities, functions, and tasks involved in conducting training (e.g., preparation, instruction, and testing). Since delivery occurs in classrooms, on job sites, or in the field, it is the most visible manifestation of training.

[11] *Training development* includes all activities, functions, and tasks involved in determining training content, location, and delivery method (e.g., curriculum design and development and the development and procurement of instructional material and technologies). It involves all design and development needed to create instructional systems and materials needed to support training in schools and in the field. *Training support* includes all activities, functions, and tasks in managing training development and delivery, including administration, maintenance, housing, and scheduling. It represents all the mechanisms needed to ensure that training development and delivery is accomplished.

[12] However, the document will discuss the need to consider training development and support in designing future restructuring initiatives.

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ORGANIZATION OF THIS DOCUMENT

Chapter Two focuses on a methodology for examining the effects of restructuring and consolidation, while Chapter Three examines the findings of relevant RAND research in terms of restructuring individual training in the military, looking at a series of studies addressing a broad range of mostly Army initiatives. Chapter Four synthesizes those findings into a series of implications for effectively and efficiently employing restructuring initiatives.

Chapter Two

METHODOLOGY FOR EXAMINING EFFECTS OF RESTRUCTURING INITIATIVES

INTRODUCTION

A number of problems must be overcome in analyzing restructuring and consolidation initiatives. Since many initiatives seek cost reduction as an explicit goal, one very important problem to overcome is the lack of detailed, well-accepted methods for analyzing the resources and costs associated with reorganizing training functions and activities. The analyst may have aggregate estimates of training costs, useful for budgeting and planning purposes, but these do not permit detailed analysis of the resources needed to reorganize training functions. Persuasive cases for restructuring have been hard to establish, including the savings that may result, and hence existing approaches to conducting training have been slow to change.

Another problem to overcome is the tendency to approach restructuring and consolidation simplistically. When analyzing restructuring, details are critical. Analysts must pay attention to the form of restructuring to be undertaken in a training program, to the details of implementation, to the "ripple" effects of change on other organizations, to the future stream of costs as well as savings, and to the tradeoffs against which savings must be considered. Such issues may identify why obvious candidates for consolidation may not be the best ones (e.g., training all cooks, etc., in one school).

More generally, because new initiatives that seek to restructure and consolidate existing training programs can have far-reaching effects on individual proficiency and unit capability, careful planning and thorough assessment is needed. Training policymakers need information on several key questions, such as the specific training pro-

grams in which new initiatives would be undertaken, how changes in training would be implemented, the cost savings that would be achieved, and other consequences of such changes.

Thus, before examining the results of RAND analyses of specific restructuring initiatives, we first describe a systematic method of analysis developed in RAND research designed to address the issues described above. The methodology specifically examines the feasibility and cost-effectiveness of new initiatives for restructuring training programs.[1] Most findings discussed in Chapter Three derive from applying one or more elements of that methodology.

The methodology includes several elements, which together (1) identify "high-payoff" potential occupations and training courses compatible with specific restructuring initiatives; (2) devise alternative approaches for restructuring training programs; (3) analyze the resources and costs of changing training programs; and (4) measure the effects and consequences of restructured training programs. The steps are illustrated in Figure 1 and discussed in more detail below.

MATCH OCCUPATIONS TO TRAINING STRATEGIES[2]

Military occupations—and the training approaches associated with them—are numerous and heterogeneous. They occur within different career management fields (e.g., infantry, engineering, or medical), cover a variety of weapons and support systems, and differ in the complexity of the required skills (e.g., operations versus maintenance). Thus, attempts to broadly restructure programs of individual training should identify and link specific occupations to restructuring initiatives.

This step involves analyzing the occupations, determining where costs could be lowered significantly through new training ap-

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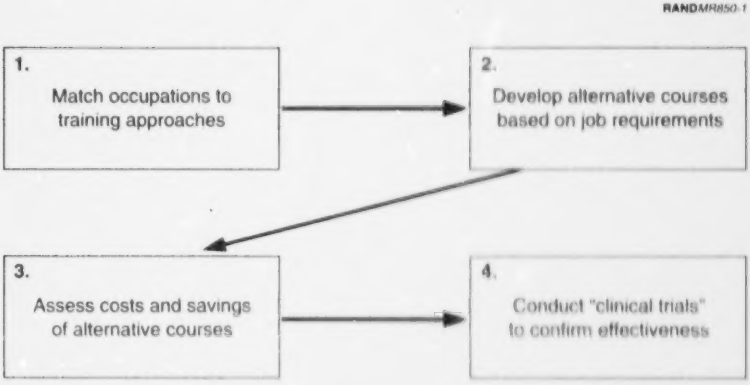
[1]See John D. Winkler, *Improving Training at School and Work: Lessons from RAND Research on Army Individual Training*, Santa Monica, CA: RAND, DB-144-A, 1995, for an overview of this method.

[2]The discussion here is derived from two RAND documents: John D. Winkler, Stephen J. Kirin, and John S. Uebersax, *Linking Future Training Concepts to Army Individual Training Programs*, Santa Monica, CA: RAND, R-4228-A, 1992; and Stephen J. Kirin and John D. Winkler, *The Army Military Occupational Specialty Database*, Santa Monica, CA: RAND, N-3527-A, 1992.

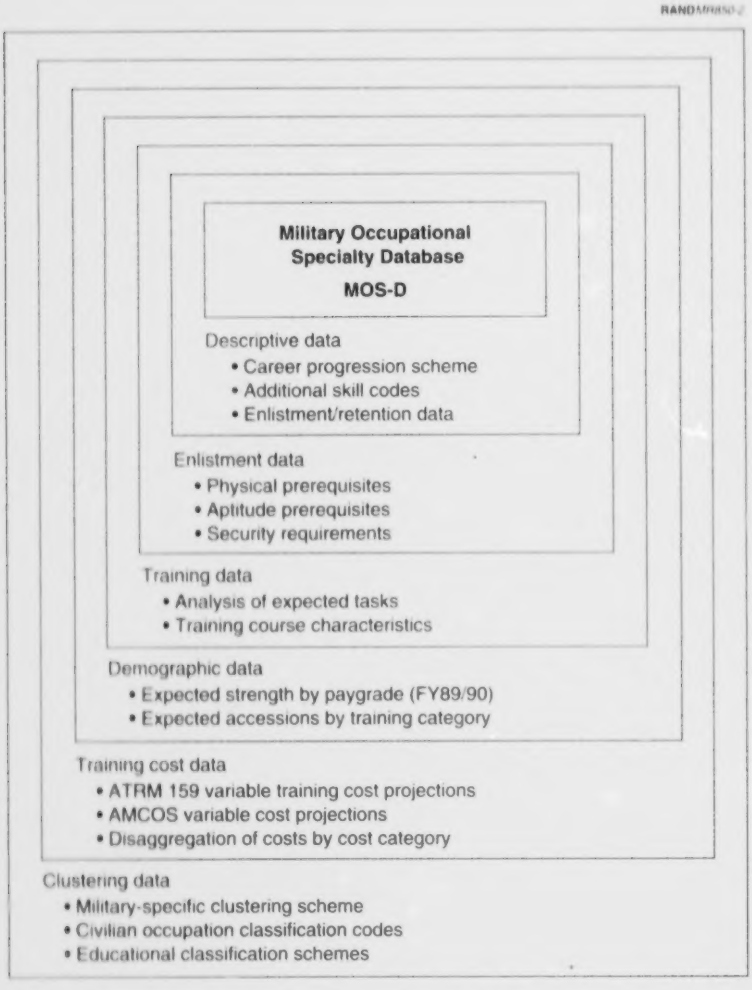


SOURCE: John D. Winkler, *Improving Training at School and Work: Lessons from RAND Research on Army Individual Training*, Santa Monica, CA: RAND, DB-144-A, 1995.

Figure 1—Overall Approach for Analyzing Restructuring Initiatives

proaches, and selecting ones with high-payoff potential. It starts by compiling data using the military occupation as the unit of analysis. RAND's research, for example, compiled a dataset specifically for this task—the Military Occupational Specialty Database (MOS-D)—which integrates information about Army MOSs from a variety of different sources. The MOS-D provides a comprehensive snapshot of the Army enlisted occupational structure, including training-related data on 317 MOSs. Figure 2 shows the six groups of characteristics that make up the MOS-D; all told, the six groups cover 147 variables.

Using the MOS-D, researchers examined characteristics of Army occupations and identified general dimensions that relate to how they may be trained. The principal training-related dimensions included ability requirements of job-holders, dominant task characteristics of the occupation (procedural or cognitive), similarity to civilian occupations, and resource intensity. These dimensions are used to identify MOSs in which new approaches to training may prove feasible and cost-effective (e.g., distance learning, expanded use of educational technologies, and use of civilian resources).



SOURCE: Stephen J. Kirin and John D. Winkler, *The Army Military Occupational Specialty Database*, Santa Monica, CA: RAND, N-3527-A, 1992.

Figure 2—The Military Occupational Specialty Database (MOS-D)

For example, Table 1 summarizes the MOSs that may be especially suitable candidates for new training concepts. These include the five MOSs with the highest total cost to train in each of three categories: distributed training (cognitive tasks dominant), training technologies (procedural tasks dominant), and civilian resources (highest in civilian exchangeability—substitution of civilian for military to conduct training, e.g., by outsourcing training functions).

DEVELOP ALTERNATIVE COURSES BASED ON JOB REQUIREMENTS[3]

For specific high-payoff occupations identified in Step 1, researchers then perform a job analysis (as shown in Figure 3). First, they collect and analyze job-related criteria (what soldiers actually do). This involves identifying the universe of relevant tasks (using task lists, occupational survey data, and subject matter expert (SME) ratings).

Table 1

Costly MOSs and Potential Training Strategies

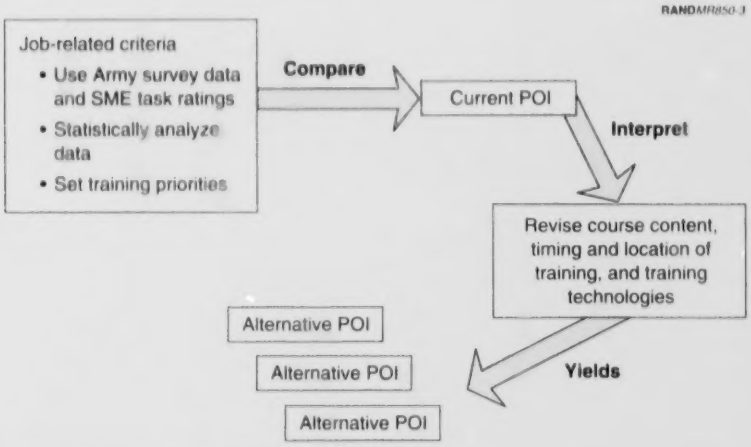
MOS	Title	Distributed Training	Training Technologies	Civilian Resources
11B	Infantryman		×	
88M	Motor Transport Operator			×
95B	Military Police	×		×
91A	Medical Specialist	×		×
13B	Cannon Crewman		×	
98G	EW/Signal Intelligence	×		×
94B	Food Service Specialist			×
13F	Fire Support Specialist	×		
54B	Chemical Operations	×		
11M	Fighting Vehicle Infantryman		×	
19K	M1A1 Armor Crewman		×	
16S	Manpads/STINGER Crewman		×	

SOURCE: John D. Winkler, Stephen J. Kirin, and John S. Uebersax, *Linking Future Training Concepts to Army Individual Training Programs*, Santa Monica, CA: RAND, R-4228-A, 1992.

[3]This discussion is derived from Hilary Farris et al., *Computer-Based Training of Cannon Fire Direction Specialists*, Santa Monica, CA: RAND, MR-120-A, 1993.

This includes all tasks that might be performed in the duty assignment for which the soldier is being prepared, including tasks from adjacent skill levels. For example, consideration of a captain's tasks includes tasks performed at the grade levels immediately above and below it. This wider selection of tasks allows for the identification of actual job boundaries, which might be different from official doctrine. This method means that some tasks may be identified for training and some may be eliminated from current training.

Next, researchers collect quantitative data about job performance from task lists, field surveys, and SME ratings of task attributes relevant to training organization and delivery to help determine whether a task is critical and also to determine "what, where, when, and how" tasks should be trained. Taken together, the SME ratings and surveys provide a more comprehensible and objective set of indicators for analyzing job requirements to determine which tasks are "minimum essential" for training in residence to prepare for the initial job assignment (versus trainable on the job), and which require hands-on experience and interaction with instructors and peers.



SOURCE: Hilary Farris et al., *Computer-Based Training of Cannon Fire Direction Specialists*, Santa Monica, CA: RAND, MR-120-A, 1993.

Figure 3—Job Analysis Method

Then, the data assembled from the surveys and SME ratings are statistically evaluated in an exploratory way; that is, researchers seek to uncover general characteristics of tasks that may be relevant to training content and delivery methods. Those results can be interpreted to guide training development (e.g., to select tasks for resident instruction or identify tasks that might be especially suitable for new training strategies and technologies).

The statistical results are then used to suggest possible changes in training content and delivery methods to improve operational efficiency and resource utilization. First, researchers consider training content, location, and timing of training (i.e., determining what should be trained in schoolhouses versus home stations and in what sequence). Then they consider the media and technology used to conduct resident and nonresident training.

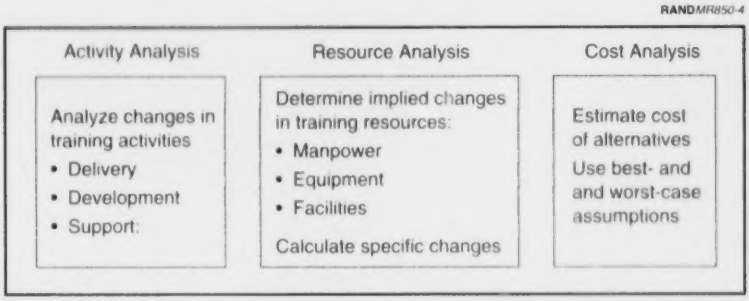
ASSESS COSTS AND SAVINGS OF ALTERNATIVE COURSES[4]

In this step, researchers analyze the resources and costs of changing training approaches using an "activity-based costing" method, which is called the Training Resource Analysis Method (TRAM). As shown in Figure 4, TRAM is generally useful for examining how restructuring and consolidation initiatives would change training activities and resource utilization.

TRAM identifies the key activities and specific resources needed to support training and shows the effects of *changes* to training activities resulting from consolidation; in turn, it estimates resource implications and costs of the changes in activities. The key training activities, as mentioned earlier, are training *delivery*, *development*, and *support*.

As shown in the figure, TRAM identifies the major resource factors to consider in estimating the costs of changes in training activities: *manpower*, *equipment*, and *facilities*. Changes to delivery, development, and support of training imply changes for the *manpower* who perform the activities, in number or by type (e.g., active versus

[4]This discussion is derived from Susan Way-Smith, *How to Estimate the Cost of Changes in Army Individual Skill Training*, Santa Monica, CA: RAND, R-4224-A, 1993.



SOURCE: Derived from Susan Way-Smith, *How to Estimate the Cost of Changes in Army Individual Skill Training*, Santa Monica, CA: RAND, R-4224-A, 1993.

Figure 4—Training Resource Analysis Method

reserve, officer versus enlisted, and military versus civilian, as well as full-time versus part-time). As training activities change, *equipment*, *material*, and *supplies* need to be acquired or disposed of, and utilization levels may change. Finally, *facility* utilization will also change, along with changes in training activities, encompassing buildings, ranges, and maintenance and other support facilities (e.g., storage facilities).

TRAM also provides other useful perspectives for analyzing the costs of changes to existing training programs. For example, it highlights one-time startup costs and annual recurring costs and savings for each of the resource factors, and it focuses on cash flows and time to break even as decision criteria for approving or disapproving restructuring initiatives. And by focusing on the details of implementation, it helps identify indirect effects and tradeoffs associated with restructuring initiatives.[5]

[5]RAND research conducted for the Air Force in the 1970s also sought to assist training resource management with methodologies that related details of course design and operation to quantitative requirements for training resources. In this approach, users input data characterizing course operations into a computer model ("MODIA") and obtained output describing resource utilization and costs. The methodology was intended to assist the planning of training by permitting comparison of alternative instructional designs. For a description of this work, see Polly Carpenter-Huffman, *MODIA: Vol. I, Overview of a Tool for Planning the Use of Air Force Training Resources*, Santa Monica, CA: RAND, R-1700-AF, March 1977.

CONDUCT "CLINICAL TRIALS" TO CONFIRM EFFECTIVENESS

In this final step, researchers take the alternatives that promise to save costs and, if there are doubts about the benefits, conduct randomized clinical trials to analyze the effectiveness of alternative training approaches. Here, we define "effectiveness" as the Office of Technology Assessment (OTA) does when it discusses the evaluation of innovative medical technologies: effectiveness is "the benefit of technology under average conditions of use" in the typical clinical setting.[6] For instance, even though a new treatment might be used by different doctors, on different patients, in different settings, for dissimilar symptoms, one still needs to know the average expected benefit before making major social investments. The consensus in medicine is that the ideal information derives from a clinical trial that compares the new medical treatment to an established treatment. Similar reasoning applies to the evaluation of new training approaches, where the "clinical trial" examines the effects in typical settings in which training is conducted.

Unfortunately, even when such assessments are conducted, much existing research on training effectiveness suffers from some common problems with research design or statistical analysis. First, many studies have used designs with insufficient statistical power to detect effects between groups. In studies that posit "no difference" or equivalence of outcomes, sample size must be sufficiently large to ensure confidence in lack of difference as a conclusion. Second, quite a few studies suffer from nonequivalence of "treatment" and "comparison" groups, through failure to randomize trainees to treatment or to compare training methods concurrently. Randomized experiments are the strongest possible methods for establishing causal relationships between independent variables (e.g., training method) and outcome variables (e.g., job proficiency). Third, some studies often used statistical analyses that failed to control for potentially confounding effects, such as differences in demographic background.

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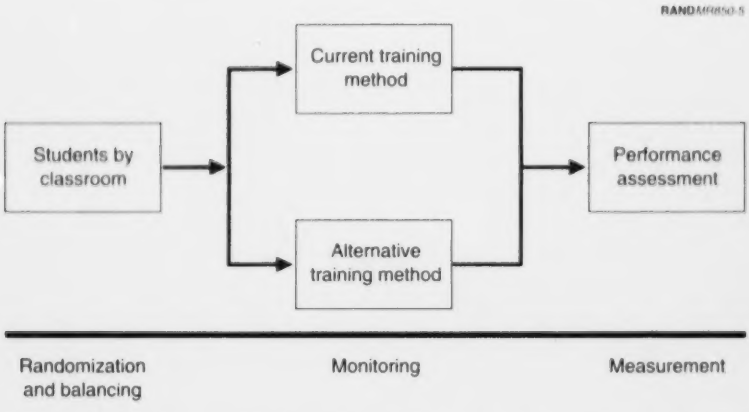
[6]Office of Technology Assessment, U.S. Congress, *Strategies for Medical Technology Assessment*, Washington, D.C.: U.S. Government Printing Office, 1982, p. 33.

Hence, in conducting clinical trials, certain design principles are paramount. The method used in the RAND studies employs classical principles: random assignment and balancing of students between control and experimental classrooms; monitoring of the intervention; measurement of training received under alternative training methods; and measurement of performance using realistic and authentic assessment (e.g., performance on hands-on tests). The approach is shown in Figure 5.

Randomizing and Balancing. In assembling students for control and experimental classrooms, researchers used a randomization and balancing model. The randomization process is fairly straightforward: Each student is assigned to either the control classroom (the existing method of training) or the experimental classroom (with the alternative training strategy) based on a coin toss or a table of random numbers. For large samples, this method minimizes differences among the groups on all types of preexisting variables, including *unmeasured* variables.



SOURCE: J. D. Winkler, *Improving Training at School and Work: Lessons from RAND Research on Army Individual Training*, Santa Monica, CA: RAND, DB-144-A, 1995.

Figure 5—Comparing Effectiveness of Alternative Training Methods

A balancing process is also used because it is often desirable to exercise direct control over the relative balance of the groups on specific variables that one knows (or believes) to be important. Intuitively, for example, if one believes that a student's initial level of, say, electronics aptitude will affect his success in the course, one would like to ensure that the two groups are as closely balanced as possible on electronics aptitude. Furthermore, there is a statistical reason for preferring close balancing. With simple randomization, the sample statistics for relevant comparisons (such as contrasts in the mean performance levels between two groups) will be unbiased, but their variance will depend on the degree of balance among other variables that affect the outcome. If one ensures, in advance, that the groups are well balanced on such causal variables, the variance of a contrast will be reduced and the comparisons rendered more precise. Researchers achieved this balance by using a method previously developed at RAND for assigning experimental units to conditions and for evaluating the degree of balance on specific variables.[7]

Monitoring. Experimental research, particularly in studies of the introduction of new training approaches, often raises issues of implementation. Typically, an experiment is designed to provide a clear contrast between a traditional method of instruction and an innovative method. However, researchers often observe that the new method is not carried out as planned; if so, the experimental intervention may fail to affect crucial intervening variables (such as substitution of resources) that played key roles in the original design of the new approach. If such an implementation failure occurs, the experiment may not shed much light on the effectiveness or the potential of the new approach. Thus, for the duration of the experiment, operations must be monitored and data recorded to ensure that the intervention being tested is used properly and thus that the experiment is in fact implemented.

Measurement. As shown in the figure, measuring how well the trainees perform with the new method—performance assessment—is a fundamental goal of the clinical trials methodology. Perfor-

[7]For a discussion, see S. James Press, "The MISER Criterion for Imbalance in the Analysis of Covariance," *Journal of Statistical Planning and Inference*, Vol. 17, 1987, pp. 375–388; and J. Michael Polich, James N. Dertouzos, and S. James Press, *The Enlistment Bonus Experiment*, Santa Monica, CA: RAND, R-3353-FMP, 1986.

mance assessment can be conducted using a mixture of hands-on tests, simulated performance (e.g., using simulators to measure how soldiers in the control classroom compare with those in the experimental class in performing a series of pertinent tasks), and written tests (e.g., questionnaires to assess trainees' job knowledge of tasks trained and their attitudes toward the training they received).

Chapter Three

FINDINGS OF RELEVANT RAND RESEARCH ON RESTRUCTURING AND CONSOLIDATION

A body of RAND research has identified conditions under which the restructuring and consolidation of training programs can be effective and efficient. These studies, which (as mentioned above) have focused most extensively on Army individual training programs, examine resources required to restructure existing programs and, in some cases, estimate the potential costs and savings that might result. In particular, the research examined a number of occupations and training courses for officers and enlisted personnel in combat and noncombat occupations in several Army branches, including armor, artillery, communications, and aviation maintenance.

This chapter includes a discussion of the research context, approach, and results of studies examining the following restructuring and consolidation initiatives:

- "Distributing" training away from centralized schools to soldiers' home stations using distance learning technologies;
- Combining two or more occupational specialties and shifting initial skill training from schools to on-the-job training (OJT) in field units;
- Using civilian vocational education programs to substitute for military programs of education and training;
- Employing training aids, devices, simulators, and simulations—collectively known as TADSS—more extensively to substitute for vehicles, equipment, and live-fire training;
- Consolidating schools offering similar programs of instruction.

The expected benefits of such restructuring initiatives include reducing duplication and improving utilization of key training resources, resulting in equivalent training delivered at lower cost. In practice, however, anticipated benefits and savings may prove illusory even in cases of obvious duplication of training functions. For example, some consolidations may require transition costs and recurring expenses that are so large they outweigh any possible savings. In other cases, consolidation *can* provide scale economies and additional benefits, but the results depend importantly on specific details about how the consolidation is accomplished.

DISTRIBUTED TRAINING PROGRAMS[1]

Research Context

The U.S. Army's Armor Officer Advanced Course (AOAC) is the professional development course for senior first lieutenants and junior captains that qualifies graduates to assume company command or function as a battalion or brigade staff assistant. The AOAC is a 20-week course and is currently taught entirely in-residence using small-group instruction. It would appear to be a good candidate for restructuring—specifically for distributed training[2]—given the expense of the current methods of instruction and the course's informational content and current resource intensity (e.g., length and requirement for permanent change of station).

Initial estimates implied that substantial cost savings were possible if the AOAC's course length were reduced and various new training media employed to provide training at soldiers' home stations. Plans called for AOAC to be reduced in length up to 60 percent (from 20 weeks to 8 weeks), with the distributed portion to be taught using paper-based techniques, computer-based training (CBT), interactive videodisc (IVD), videotape, and training devices.

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[1]This discussion is drawn from John D. Winkler, Susan Way-Smith, Gary Moody, Hilary Farris, James P. Kahan, and Charles Donnell, *Distributed Training of Armor Officers*, Santa Monica, CA: RAND, MR-118-A, 1993.

[2]As described in doctrinal publications, distributed training envisions a reduction in the length of initial entry courses, accompanied by the use of "distance learning technologies" to train individual skills in field units "at the time and place when needed" (TRADOC, 1990).

However, many of the details needed to implement the distributed training were lacking. For example, specific course material best suited for distributed training was not defined. Likewise, support requirements for distributed training were not specified. Cost savings were estimated using aggregated cost and manpower estimating relationships, not specific course-level costs and savings.

Research Approach

RAND's analysis sought to determine the extent and nature of changes that were feasible (given key course objectives) and cost-effective. Specifically, researchers examined the feasibility of restructuring the existing program to incorporate distributed training, as well as costs and savings under different assumptions about how distributed training would be implemented.

Drawing on Step 1 analysis results, which showed that distributed training might prove cost-effective in leader development courses like the AOAC, researchers used Step 2 job analysis methods to select 251 AOAC tasks and 17 measures for each task. Eight of the measures were derived from the 1990 Armor Occupational Survey Program (AOSP) field survey of armor officers, eight measures of task attributes were provided by SMEs, and one common task indicator came from the Master Task List developed earlier under the Systems Approach to Training.

Factor analysis of the 251 tasks and 17 measures yielded five general dimensions of armor captain tasks—critical company grade, frequent procedural, interactive leadership, urgent field command, and combined arms tasks—that contribute to the interpretation of an armor captain's duties. Having identified these five dimensions, research defined and analyzed alternative POIs that were consistent with the goal of restructuring AOAC for distributed training while supporting fundamental course objectives. This process involved examining the current POI in light of the job analysis results to identify those tasks that were core and had to remain in-residence, those that were not in need of training (e.g., because they are not actually performed by armor captains) and thus could be eliminated, and those that could be distributed for nonresident instruction (because they did not involve tasks fundamental to initial command or staff duties).

Given the percentage of the course that could be distributed, the analysis used the resource and cost methodology in Step 3 to identify the cost-effectiveness of various mixes of media under best-case (low-cost) and worst-case (high-cost) assumptions, identifying startup costs and break-even times.

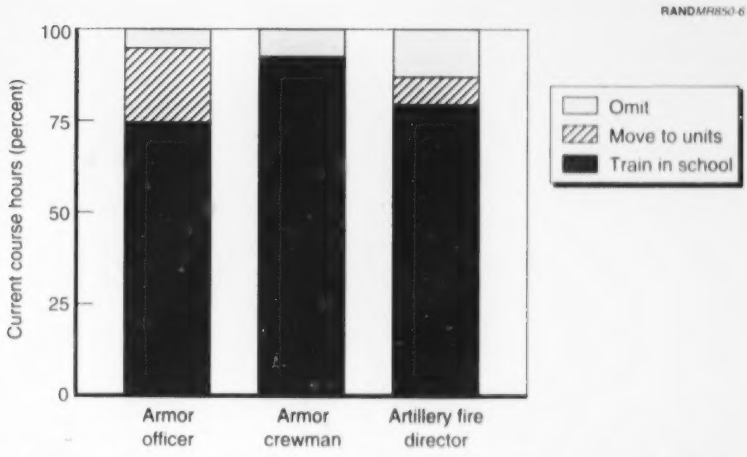
Research Results

The job analysis revealed that the potential for distributing training in the AOAC was more limited than originally thought. Where initial estimates stated that 60 percent of the AOAC POI hours (12 of the 20 weeks) could be conducted through distributed training, the analysis showed that only 20 percent (4 of the 20 weeks) seemed amenable to distributed training. These weeks entailed orientation and background information, routine administrative tasks, and tasks shown in the analysis to be least important for preparing units and directing wartime operations.

Of the remaining 80 percent of the course hours, 75 percent (15 of the 20 weeks) needed to remain as in-resident instruction. These weeks entailed training toward attaining proficiency at tasks identified as the most important for preparing units for combat operations and planning and directing company tactical and logistical operations in wartime. They also included some of the key tasks needed to perform staff functions in battalions and brigades. Consistent with the current course objectives, the resident POI emphasized the use of small-group instructional techniques to provide this training.

The remaining 5 percent (one week) of current AOAC POI hours represented unnecessary training for armor captains and could be "trimmed" from the current POI to accomplish necessary cost savings. The tasks consisted of those identified as least related to AOAC core training objectives and the duties of armor captains (e.g., portions of the Army Writing Program).

Although the job analysis showed that only 25 percent of the AOAC POI hours could either be distributed to units or omitted, Figure 6 shows that this amount was actually considerably larger than the amounts that similar job analyses revealed for two other training courses.



SOURCE: J. D. Winkler, *Improving Training at School and Work: Lessons from RAND Research on Army Individual Training*, Santa Monica, CA: RAND, DB-144-A, 1995.

Figure 6—Comparison of Armor Officer, Armor Crewman, and Artillery Fire Director Current POIs

The figure shows that there seemed to be a good alignment between schoolhouse instruction and job requirements in the training courses researchers examined. Specifically, most material needed to perform the job, requiring training in school (in-residence), was trained in school—75 to 93 percent of the current course hours in these cases.

One of the more important insights from the cost analysis was the degree to which implementation details proved crucial to the amount of cost savings from distributed training. Specifically, these included the type of changes made to training delivery, development, and support activities. On the training delivery side, this entailed changes in facilities and equipment, manpower, and training time; on the development side, changes in product development; and on the support side, changes in logistics and maintenance. The cost analysis used the set of low-cost and high-cost assumptions

Table 2

Assumptions Used in Cost Analysis for AOAC Training Options

Training Functions	Resources/ Activities	Assumptions: Low Cost	Assumptions: High Cost
Delivery	Facilities and equipment	No new	New/remodel
	Manpower	No new	Additional
	Training time	Off duty	On duty
Development	Product development	Fixed cost	Hourly rates
Support	Logistics and maintenance	Low	High

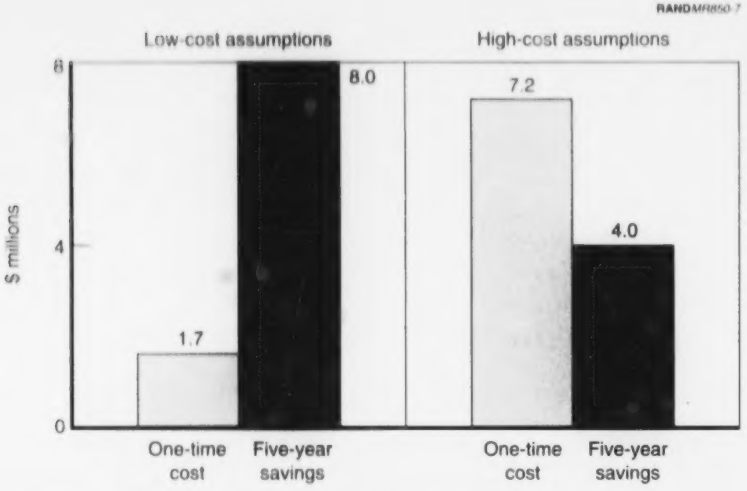
SOURCE: J. D. Winkler, *Improving Training at School and Work: Lessons from RAND Research on Army Individual Training*, Santa Monica, CA: RAND, DB-144-A, 1995.

shown in Table 2 for these three training functions. The research found that the level of costs and savings depended most significantly on the assumptions about training delivery, specifically on how much and what type of new infrastructure was needed.

Figure 7 compares costs and savings under the two sets of cost assumptions. If the restructuring could be accomplished using existing training equipment and facilities, then distributed training could provide significant savings with a very quick payback. For a one-time cost of $1.7 million, savings would accrue quickly, totaling $8 million by the end of a five-year period (a break-even point of one year).

If, however, it was necessary to develop new distributed training products, acquire and maintain additional training delivery systems, remodel and expand learning centers, and so forth, then startup costs would have increased, and recurring savings, if any, would have been much more modest. In this case, the initial startup costs would have increased (from $1.7 million to $7.2 million). At the same time, the recurring savings would have decreased considerably (from $8 million in five years to only $4 million). The break-even point would therefore have gone from one year to nine years.

The level of costs and savings also depended on how manpower resources were handled during restructuring. If changes increased



Source: J. D. Winkler, *Improving Training at School and Work: Lessons from RAND Research on Army Individual Training*, Santa Monica, CA: RAND, DB-144-A, 1995.

Figure 7—Comparison of AOAC Distributed Training Costs and Savings Under Low- and High-Cost Assumptions

manpower requirements (e.g., for personnel to oversee and manage distributed training in the unit), this would have offset any savings in school personnel. Moreover, no real savings from manpower reductions would have occurred if affected personnel are reassigned to other positions without a corresponding decrease in end strength.

Another striking cost-analysis finding was that the mix of media used for training delivery had a very large effect on cost. Options examined included a "low-tech" mix using only paper-based products (e.g., reading material and worksheets), a "medium-tech" mix of CBT, paper, and videotape, and a "high-tech" mix that included videoteletraining. The medium-tech mix was the mix used to generate the costs and savings shown on Figure 6. Startup costs and operating costs increase as the media used to deliver training increase in technical complexity. For example, the research estimated that one-time startup costs in this course could range from a "best case"

of $1.6 million for the low-tech mix to a "worst case" of $9.2 million for the high-tech mix. Moreover, operating and maintaining high-tech media could cost more than current methods of instruction even under the most optimistic assumptions.

In general, the research showed that as training delivery media became more complex, startup costs increased, recurring savings decreased, and payback periods lengthened. And the obsolescence of the curricula also needed to be taken into account in evaluating training media investments and anticipated payback periods.

CONSOLIDATED OCCUPATIONS WITH EXPANDED OJT[3]

Research Context

Another restructuring initiative, intended to provide training at lower cost without compromising mission effectiveness, is an approach termed "field-based crosstraining" (FBCT),[4] which refers to programs that include the following features:

- **Consolidating two or more MOSs.** The numbers of distinct, related occupations are reduced by combining specialties.
- **Shifting from school to on-the-job training.** Courses in Advanced Individual Training (AIT)[5] are shortened and reoriented to focus on general "core" skills. Simultaneously, the shift usually involves a formal OJT program at the field unit to compensate for the reduction in schoolhouse training.

FBCT programs are intended to substantially reduce costs associated with the schoolhouse training by reducing course length, which is resource-intensive and which some argue may overtrain individuals for tasks they are asked to perform early in their field assignments—tasks that trainees might be able to learn during OJT. These pro-

[3]This discussion is drawn from William G. Wild, Jr., and Bruce Orvis, *Design of Field-Based Crosstraining Programs and Implications for Readiness*, Santa Monica, CA: RAND, R-4242-A, 1993.

[4]Such programs also have been referred to as "generic" or "apprentice" programs.

[5]AIT courses immediately follow basic training and certify enlisted personnel in their MOSs just before their first unit assignment.

grams are also intended to obtain cost savings in course development and personnel management by absorbing low-density MOSs and reducing the numbers of separate MOSs in a career management field.

At the same time, FBCT programs are expected to increase organizational flexibility in meeting the unit workload by consolidating MOSs and, thereby, making it easier to match individuals with slots in field units. In addition, by creating "broader" MOSs, they are expected to increase personnel system flexibility and operational efficiency by permitting more efficient assignment of people to tasks in the unit.

But FBCT programs also have risks: (1) when training is shifted from AIT to field OJT, AIT graduates enter the unit with less background directly relevant to their MOS; (2) with less preparation, AIT graduates are likely to require a longer "train-up" period, during which they may need more supervision and perform less proficiently; (3) when MOSs are consolidated, breadth of training during OJT is emphasized at the expense of depth in particular work areas, which could adversely affect unit performance.

Research Approach

RAND's analysis thus sought to assess the features, advantages, and disadvantages of FBCT programs. Specifically, the analysis developed a methodology for addressing these issues and applied it to the specific case of Army helicopter maintenance. This case was chosen because the Army was considering a major restructuring of aviation maintenance training under a proposed FBCT program called the "Apprentice Mechanic Initiative" (AMI)—a proposal that was later scaled back significantly given the results of this research.

AMI's principal features included (1) consolidating 13 separate aviation maintenance MOSs into a single MOS for first-term enlistees; (2) consolidating the corresponding AIT courses into a single program; (3) revising the content of AIT, significantly reducing courses from their current length (13–30 weeks) to around 8–10 weeks (in its shorter version, the course was to focus on aircraft familiarization, basic hydraulics, engine characteristics, technical manuals, common/special tools, maintenance forms, and safety); (4) assigning all AIT graduates to about 18 months in Aviation Maintenance Units

conducting intermediate maintenance (AVIM), where they would receive an OJT program exposing them to all MOS areas; and (5) placing field training detachments (FTDs), drawn from schoolhouse personnel, at AVIM to help guide and verify training.

To assess the potential impact of FBCT programs in the field, RAND researchers developed a methodology that compared anticipated operations under FBCT systems with those under the current system—an approach that has much in common with the job analysis methodology discussed above. The analysis was intended to highlight key issues, areas for attention, and benefits and risks in a way that either informed a field experiment or was used in lieu of field experiments where it was not (as in this case) feasible to perform them.[6]

For this study, the analysis entailed building a baseline of information describing current helicopter maintenance operations, including types of work performed by personnel of varying experience levels, unit types, and MOSs; volume and mix of the day-to-day maintenance workload; unit manning patterns by MOS and pay grade; and unit organization and operational procedures. Data to build the baseline were drawn from interviews with helicopter maintenance personnel in active field units; they were also drawn from field surveys administered to over 100 maintainers and 100 supervisors during visits to field units. Separate maintainer and supervisor surveys were developed (one for each of the MOSs considered for consolidation) based on a template of several hundred key tasks for each MOS. The task lists were, in turn, assembled from official Army sources, primarily Soldier's Manuals and Maintenance Allocation Charts (MACs), with additional review and input from SMEs.

Research Results

MOS consolidation. As discussed above, one of the projected benefits of MOS consolidation is flexible work allocation. For example, when personnel are specialized into MOS A and MOS B, workers of

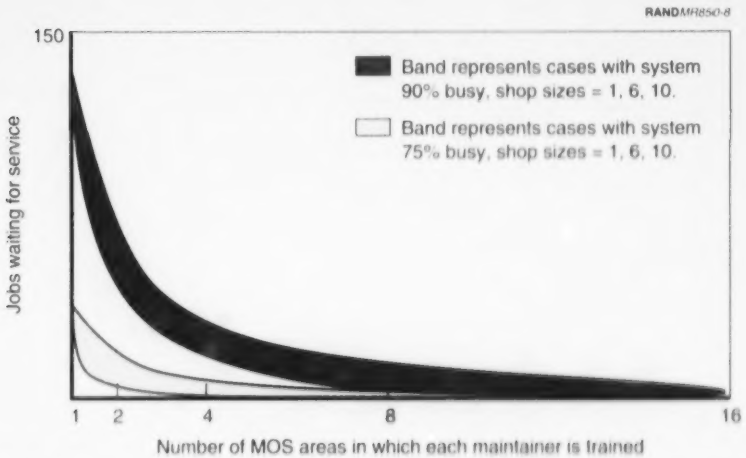
[6]An experimental field test—i.e., test programs at units and measure the outcomes—is a highly beneficial way of evaluating training programs, as discussed previously. However, such an approach is not feasible in certain cases, given the disruption it might be to unit operations.

MOS A may stand idle due to temporary lack of "type A" work, while "type B" jobs queue up (or vice versa). Similarly, one type of worker may be working on a relatively low-priority job, while higher-priority jobs queue up at the other work center. Clearly, when personnel are capable of both types of work, such instances can be remedied. For a program like AMI, the added flexibility from crosstraining personnel was intended to yield gains in effectiveness from the same number of personnel man-hours by producing the following two benefits: (1) decreasing the number of jobs waiting for service, and (2) increasing the potential for greater average unit productivity.

In terms of the first benefit, using basic queuing modeling over a wide range of assumptions[7] yielded the results shown in Figure 8, which shows how MOS consolidation (on the x-axis) affects the number of jobs waiting service (on the y-axis). The uppermost band in the figure summarizes the cases in which the system is very busy (workers occupied 90 percent of the time), and the shop sizes range from one to six to ten personnel. The lower band represents cases in which the system is less busy (occupied 75 percent of the time), for the same range of shop sizes. As expected, in all cases, the total number of jobs waiting for service declined as consolidations took place. However, approximately 50 percent of the total improvement was realized when workers were crosstrained into just one other MOS. More generally, a fundamental trend was apparent: *When crosstraining across MOSs, the bulk of the queue reduction was achieved with the first few consolidations. As the scope of crosstraining increased beyond these, the payoffs diminished rapidly.* Intuitively, this could be translated to mean that "not everybody needs to be able to do everything," because the system could rarely if ever make use of that much flexibility.

Results addressing the second type of potential benefit—increases in average productivity that might occur if the system is overloaded during wartime—were situational but nonetheless similar to those

[7]The trend shown in the figure is a fundamental characteristic of the queuing system in that it holds true over a wide range of assumptions: varying shop sizes (1, 6, and 10 servers), with servers both very busy (.90) and not so busy (.75, .50, and .25); combining shops of unequal size (1 and 10 people); combining shops of unequal utilization (.3 and .9); and fast-paced systems (many short jobs arrive and are served per day by the server) and slow-paced systems (the opposite).


RANDMR850-8
150
Band represents cases with system 90% busy, shop sizes = 1, 6, 10.
Band represents cases with system 75% busy, shop sizes = 1, 6, 10.
Jobs waiting for service
1
2
4
8
16
Number of MOS areas in which each maintainer is trained

SOURCE: William G. Wild, Jr., and Bruce Orvis, *Design of Field-Based Crosstraining Programs and Implications for Readiness*, Santa Monica, CA: RAND, R-4242-A, 1993.

Figure 8—Diminishing Returns of MOS Consolidation

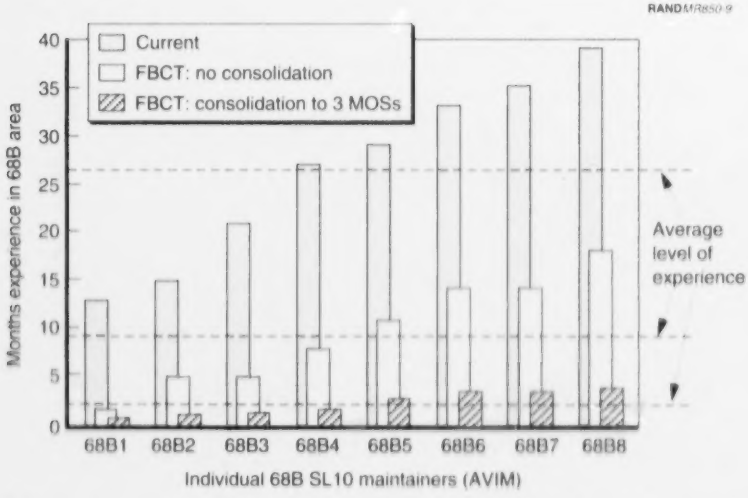
shown in Figure 8: For many types of scenarios—for example, eight overloaded MOSs and eight underutilized ones, or four overloaded and twelve underutilized ones—most (about two-thirds) of the potential gain would be captured with crosstraining to four MOS areas.

Thus, given the results for both benefits, large-scale MOS consolidations in helicopter maintenance such as those proposed for AMI (i.e., from many to a single or two MOSs) might yield undesirable consequences. Selective consolidations—to a number intermediate between five and the current thirteen in helicopter maintenance—seemed to offer the best plan for maintaining capability while reducing training resources. To minimize risk, consolidations should encompass highly transferable skills and be augmented with policies that facilitate flexible assignment of personnel in units. Training packages to support cross-utilization of similar MOSs could be used to enhance flexibility without formal consolidation.

Shifting training from AIT to OJT. In shifting training from AIT to OJT, three elements of the shift were important: (1) placement of

students (whether trainees were dispersed across unit (AVUM) and intermediate maintenance (AVIM) facilities or centralized at one or the other); (2) source of OJT (whether the OJT was based only on workload occurring during duty time or supplemented with activities outside duty time); and (3) amount of training shifted to OJT (how many and what types of tasks covered in AIT that are assigned to OJT).

In terms of the first element, centralized placement of OJT appeared feasible for helicopter maintenance because of the similarity of the types of work and functions performed at AVIM and AVUM within an existing MOS. Hence, skills OJT trainees developed at one maintenance level might be broadly transferable to the other. However, dispersed OJT across both unit types—the current practice—might be desirable, because centralizing OJT at AVIM could impose unacceptable losses in experience levels in AVIM units (as shown in Figure 9).



SOURCE: William G. Wild, Jr., and Bruce Orvis, *Design of Field-Based Crosstraining Programs and Implications for Readiness*, Santa Monica, CA: RAND, R-4242-A, 1993.

Figure 9—Effects of Training Programs on Maintainer Capability

Figure 9 uses the MOS 68B area to illustrate the experience level of entry level (SL 10) maintainers at AVIM.[8] Under the current system (represented by the upper columns), personnel experience levels averaged about 26 months; however, under a centralized 18-month OJT program limited to AVIM (the middle columns), the experience levels were reduced to around 9 months. And as the lower set of columns shows, the experience decrement worsened significantly under consolidation: With 13 aviation maintenance MOSs consolidated into three MOSs, with each composed of four or five of the current ones, SL 10 personnel would possess only 2.25 months experience on average in each of the four current MOSs.[9]

In terms of source of OJT, helicopter maintenance OJT probably would need to rely on the naturally occurring workload. It appeared that expectations of using "outside time" for OJT would founder because of labor shortages in units, which arise from the combination of their maintenance and nonmaintenance duties.

Finally, in terms of the amount of training shifted from AIT to OJT, it did not seem that task training could be delegated readily to a field OJT program in helicopter maintenance. Analysis of three MOSs found insufficient workload to ensure that trainees would gain sufficient exposures to difficult tasks to learn them in OJT. Training such tasks would require grouping them into training blocks, or, in the extreme, concentrating exposures to the tasks within a block across a limited number of trainees.

Thus, the research showed that for the proposed AMI program, reductions in the length of AIT courses offered potential benefits; however, the resulting increases in OJT requirements placed additional burdens on field units that could offset the benefits and decrease readiness. Graduates of shortened AIT courses would enter the unit with less MOS-relevant background, making their train-up period longer and lowering their experience. Moreover, when combined

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[8]Displays of experience levels for SL 10 AVIM personnel in other 67/68 series MOSs show similar patterns; thus, 68B is used here as a representative example.

[9]Similar results were found for a measure of unit capability. See William G. Wild, Jr., and Bruce Orvis, *Design of Field-Based Crosstraining Programs and Implications for Readiness*, Santa Monica, CA: RAND, R-4242-A, 1993.

with consolidation, such programs incurred a high risk of decreased individual and unit capability.

First priority should therefore be given to understanding what savings could be realized with minimal increases in OJT requirements,[10] including dropping unneeded materials from AIT courses and, more broadly, coordinating training of general skills and specific types of tasks with unit workload levels.[11]

USE OF CIVILIAN RESOURCES TO PROVIDE MILITARY TRAINING[12]

Research Context

In the Defense Authorization Act for fiscal year 1990, Congress briefly outlined new approaches to training and directed DoD to consider implementing them: (1) pre- or postaccession technical training (i.e., noncombat, including electricity, machinery, welding, surveying, journalism, and photography) provided by institutions of higher education and vocational schools; (2) encompassing both active and reserve forces; and (3) providing a stipend during the preaccession training. Congress's concerns with civilian-provided training as a substitute for military-provided training focused on the following questions:

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[10]This study did not estimate the cost savings that could result from better aligning training programs with job requirements and dropping unneeded materials. However, two other studies did this. In the analysis of the AOAC (discussed earlier), the research found that eliminating one week of presumably "unneeded" material could save approximately $670,000 for this course. Another study estimated potential annual savings of $190,000–$280,000 if 50 hours of "unneeded" instruction were eliminated from the entry-level course for fire direction specialists. See John D. Winkler et al., *Distributed Training of Armor Officers*, Santa Monica, CA: RAND, MR-118-A, 1993; Hilary Farris et al., *Computer-Based Training of Cannon Fire Direction Specialists*, Santa Monica, CA: RAND, MR-120-A, 1993.

[11]RAND research for the Air Force has examined conditions under which OJT may be effective. For examples of this work, see Polly Carpenter-Huffman, *The Cost-Effectiveness of On-The-Job Training*, Santa Monica, CA: RAND, P-6451, February 1980; Polly Carpenter-Huffman, *Putting On-The-Job Training Under New Management to Improve Its Effectiveness*, Santa Monica, CA: RAND, P-6314, March 1979.

[12]The discussion in this section is drawn from Lawrence M. Hanser, Joyce N. Davidson, and Cathleen Stasz, *Who Should Train? Substituting Civilian-Provided Training for Military Training*, Santa Monica CA: RAND, R-4119-FMP, 1991.

- Can civilian institutions provide technical training at equal or lower cost and equal or higher quality?
- Can training reasonably be provided by civilian institutions within a preaccession scenario?
- Can civilian-provided training enhance the readiness of the Reserve Components?

More recently, the Commission on Roles and Missions of the Armed Forces has expressed similar hopes about the potential for "privatization" or "outsourcing" to accomplish savings for a number of defense support functions, including defense education and training.[13]

Research Approach

This study analyzed the issues associated with the feasibility of using civilian-based training institutions to provide Initial Skill Training (IST) programs for Armed Forces personnel.[14] To do this, researchers surveyed the history of civilian-provided technical training programs at the time and supplemented this with interviews to gather current viewpoints and information about ongoing programs. In the military sector, this involved interviewing key actors in the U.S. Army Training and Doctrine Command (TRADOC), U.S. Navy Chief of Naval Education and Training (CNET), Chief of Naval Technical Training (CNTECHTRA), and Civilian-provided Training Resources Program, U.S. Air Force Air Training Command (ATC), U.S. Army Deputy Chief of Staff for Operations and Plans (DCSOPS), U.S. Navy Personnel Research and Development Center (NPRDC), Department of Defense Training and Performance Data Center (TPDC), and Office of the Assistant Secretary of Defense for Force Management and Personnel (OASD (FM&P)). In the civilian sector, researchers spoke with representatives from the American Association of Community and Junior Colleges (AACJC) and several other trade and technical associations. Simultaneously, researchers developed a strategy for

[13]*Directions for Defense*, Report of the Commission on Roles and Missions of the Armed Forces, May 24, 1995.

[14]IST is the equivalent of AIT, Tech Training, C-School, or A-school.

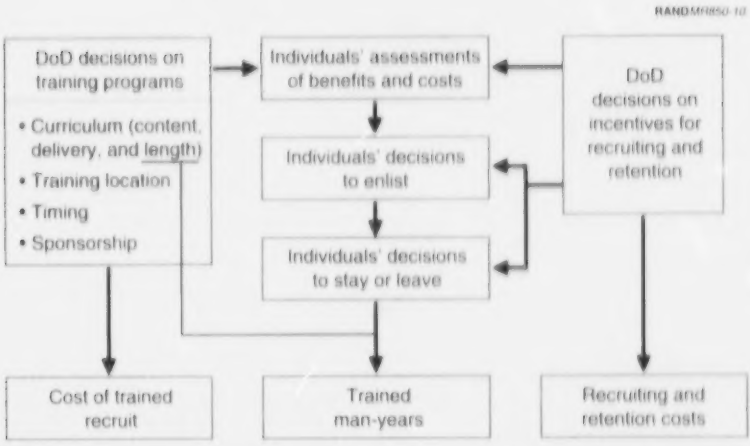
comparing alternative programs that entailed a conceptual framework to improve on simple cost modeling.

Research Results

The review of past and current programs revealed that although the services had some limited experience with civilian-provided training programs, they had not systematically evaluated their programs in a way that provided answers to congressional concerns. Specifically, there was a lack of data to systematically evaluate the feasibility of civilian-provided training on cost, quality, or other grounds. For example, in terms of costs, one argument for using civilian-provided training was that it would reduce costs over military-provided training. Clearly, many military occupations have direct civilian counterparts (e.g., vehicle mechanic, cook, and carpenter) and many military occupations rely on basic knowledge that can be trained in the civilian sector (e.g., electronics). But how do the saving/costs of civilian-based training vary for preaccession versus postaccession, for prior service versus nonprior service, and for active versus reserves? And beyond straight monetary savings/costs, what are the implications of civilian-based training for such issues as enlistment, attrition, and reenlistment? For example, while civilian-based training may increase enlistment by providing recruits with a means of obtaining valuable training that will later facilitate entry into a civilian job, it may also, for the same reason, serve as a disincentive for reenlistment and a source of increased attrition.

Because the review of past and current programs left unanswered such basic questions about the comparative cost-effectiveness and quality of military and civilian-provided training, the study developed a conceptual framework (shown in Figure 10) as the core of an approach for evaluating future alternative programs. The study suggested a single measure of trained man-years (TMY)—shown in the middle box at the bottom of the figure—to calculate the output associated with alternative training programs.[15] TMY was based on

[15]Trained man-years measure the number of years of an individual's services that are available to an employer after the individual has completed training. For example, if an individual completes a four-year term of service, but is in training for one year, that individual contributes four man-years but only *three* trained man-years of service.


RAND MR850-10
DoD decisions on training programs
• Curriculum (content, delivery, and length)
• Training location
• Timing
• Sponsorship
Individuals' assessments of benefits and costs
Individuals' decisions to enlist
Individuals' decisions to stay or leave
DoD decisions on incentives for recruiting and retention
Cost of trained recruit
Trained man-years
Recruiting and retention costs

SOURCE: Lawrence M. Hanser, Joyce N. Davidson, and Cathleen Stasz, *Who Should Train? Substituting Civilian-Provided Training for Military Training*, Santa Monica, CA: RAND, R-4119-FMP, 1991.

Figure 10—Conceptual Framework for Factors Determining Trained Man-Years and the Costs of Producing Them

the expected number of enlistments and the expected life cycle over which that cohort was occupationally qualified. The best use of training dollars would then entail selecting the option that minimized the present discounted value of the stream of costs for each option that produced a given level of TMY over the relevant time horizon.

TMY directly depended on the individual's assessments of the benefits and costs of enlisting and then attriting or reenlisting. These assessments were, in turn, driven by DoD decisions about providing incentives for recruiting and retention and by DoD decisions on the nature of the training programs it offers. Both categories of DoD decisions had costs, the former in terms of recruiting and retention and the latter in terms of training the recruit.

As shown in the figure, the DoD's choice of training programs could influence an individual's assessment of benefits and costs. The

training programs themselves, military or civilian, needed to be assessed in terms of the four characteristics shown in the figure: curriculum (content, delivery, and length), training location, timing, and sponsorship. The implications are discussed below.

In terms of curriculum content, delivery, and length, if the civilian curriculum had the effect of increasing postservice earnings, then recruiting and student compensation costs could be reduced without lowering enlistment. However, the costs of keeping the trained manpower would rise if greater compensation incentives had to be provided to induce reenlistment. Length, in particular, as shown in the figure, could directly affect TMY, because the military could either extend the period of initial obligation dependent on the length of training or shorten the amount of training during the enlistment period. Either option would increase TMY.

In terms of location, a program of local training could greatly reduce change-of-station costs and associated living allowances by providing training near a recruit's home prior to entrance. However, this had attendant risks that might increase costs associated with maintaining a given level of TMY. In particular, local training might raise a recruit's costs of leaving the community by providing more information about community opportunities and allowing more time for developing relationships with civilian employers. In addition, a program of local training required that outside providers be initially screened. The cost associated with such screening would depend on the number of institutions under consideration and the complexity of the program.

In terms of timing, two costs were potentially affected by offering training prior to enlistment. First, student compensation costs were more flexible under a preaccession training program and might be reduced. Second, because of the delay between training and first duty assignment, there might be considerable skill decay that would then require refresher training. Hence, any cost savings that might be realized from a preaccession program could be at least partially offset.

Finally, in terms of sponsorship, many recruits enlisted as a way of receiving training that they were unable to finance themselves. The degree to which the costs of training could be shifted to the recruit

would depend on how the training costs affect the net returns associated with military service.

Based on this conceptual framework, researchers hypothesized that civilian IST programs could be expected to have effects on recruiting, performance during training and beyond, attrition, and reenlistment, as well as on the marginal and fixed costs of training. That is, through a number of complex mechanisms, civilian-provided IST programs could be expected to affect the cost and quantity of TMY available to the services.

Although the study revealed that civilian-based training programs had not been systematically evaluated using even the simplest cost model, the research did reveal that many military occupations seem amenable to civilian-provided training[16] and that, indeed, viable programs of contract training existed in the Navy, Army Reserve, and Army National Guard. Moreover, based on information gathered from a literature review, site visits, and analysis of the issues and mechanisms involved, the study argued there could be real benefits to expanding civilian-provided IST in some circumstances. For example, for prior-service reservists and guardsmen whose active-duty occupations do not match their reserve or National Guard duty assignment, providing civilian training locally might lessen resources required for training development, delivery, and support, while increasing training availability and readiness. The benefit for non-prior-service reservists, however, was mixed, because of both the relatively short amount of time they spend at active-duty training and the services' concerns with inculcating military values. It might be important for these individuals to attend IST in a military environment to reinforce the military values taught in recruit training. On the other hand, because of the civilian environment in which reservists and guardsmen live and work, an additional few months of exposure to military values during IST might have little impact in the long run. For active forces, the question of using civilian-provided

[16]See also John D. Winkler, Stephen J. Kirin, and John S. Uebersax, *Linking Future Training Concepts to Army Individual Training Programs*, Santa Monica, CA: RAND, R-4228-A, 1992; and Stephen J. Kirin and John D. Winkler, *The Army Military Occupational Specialty Database*, Santa Monica, CA: RAND, N-3527-A, 1992. These documents analyze similarities between Army MOSs and civilian occupations and education and training programs. They note, for example, that a closely analogous civilian occupation exists for approximately 85 percent of Army entry-level enlisted MOSs.

IST was far more complex and required more data and analysis to determine if there were savings or differences in the quality of training.

The research also revealed that there are significant institutional barriers to implementation in the military and that without appropriate incentives, the services would tend to shy away from civilian-provided IST. In addition, even if military objections were overcome, criteria for selecting civilian institutions, monitoring training and its outcomes, and so forth, would have to be worked out.

Finally, because there was a lack of readily available information about either the cost or quality of training to do any kind of evaluation, the study suggested obtaining such information by conducting a series of demonstration projects using scenarios involving both preaccession and postaccession, as well as active and reserve component, programs.

EXPANDED USE OF TRAINING TECHNOLOGIES

One of the key ideas for restructuring and consolidating training in the military is to make better use of training technologies, including training aids, devices, simulators, and simulations (TADSS) and interactive, computer-based training (CBT) systems. RAND studies have examined the use of training technologies for both individual training in Army schools and for collective training in units. Below we look at two sets of individual training studies—one on device-based training for armor crewmen and one on the effectiveness of interactive videodisc (IVD) in Army communications training—and one collective training study that examines the use of simulations for large-scale exercises.

Device-Based Training for Armor Crewmen[17]

Research context. MOS 19K OSUT is the 14-week initial entry training course for new armor enlisted tank crewmen who will serve on the crew of M1 or M1A1 Abrams tanks. As an Army One-Station Unit

[17]The discussion in this subsection is drawn from Gary Moody et al., *Device-Based Training of Armor Crewmen*, Santa Monica, CA: RAND, MR-119-A, 1993.

Training (OSUT) program, the course combines basic soldier training with AIT in a specific occupational specialty. Sixty percent of the course involves basic soldier training, while the remaining 40 percent is vehicle-specific training designed to train each soldier to perform a wide variety of day-to-day tasks in his duty description. Specifically, the student receives loader, driver, and gunner training,[18] with the intent of producing a soldier *qualified* to be a tank loader, *familiar* with driver's duties, and *familiar* with gunner's controls and equipment.

Given its heavy use of tanks and its emphasis on procedural and maintenance tasks, MOS 19K OSUT seems to be a good candidate for expanded use of TADSS. Training costs are high, and increased use of training technology to substitute for hands-on training could save resources. However, analysis is needed to determine possible costs and benefits.

Research approach. This study evaluated the options for greater use of TADSS during initial entry training for enlisted tank crewmen. Specifically, researchers sought to determine how much training could actually be conducted using TADSS and how this might be most cost-effectively developed and supported.

The approach to meet these objectives followed the approach used in the study of the AOAC discussed above—a job analysis, followed by a cost analysis. Drawing on Step 1 analysis results showing that the concept of TADSS might prove especially cost-effective in courses like the MOS 19K OSUT in which procedural tasks are dominant, researchers then used Step 2 job analysis methods to select 206 MOS 19K OSUT tasks and 12 measures to analyze them with. Two of the measures were derived from the 1990 Armor Occupational Survey Program (AOSP) field survey of armor crewmen, three were provided by the 1990 AOSP supervisor survey administered to senior enlisted armor crewmen, and the remaining seven reflect the sys-

[18]The tank loader is the person responsible for operation and maintenance (O&M) of the tank's main gun and coaxial machine gun, the driver is responsible for driving the tank in both tactical and nontactical situations and for conducting O&M on the vehicle's hull components, and the gunner is responsible for engaging targets with the tank's fire control equipment.

tematic judgments of armor school SMEs about attributes of armor tasks relevant to training organization and delivery.

Factor analysis of the 206 tasks and 12 measures yielded four general dimensions of armor crewman tasks—frequent MOS 19K tasks, enabling tasks, combat survival tasks, and crew combat tasks—that contribute to the interpretation of an armor crewman's duties.

Having identified these four dimensions, researchers examined alternative POIs that were consistent with a device-based training strategy but remained true to the principal training objectives of MOS 19K OSUT. Given the principles of a device-based training strategy, researchers sought to identify training events where on-vehicle training could be replaced by TADSS and where platform instruction could be done with CBT or videotapes.

Given the amount of the course that could make use of expanded training technologies, the analysis used the resource and cost methodology in Step 3 to identify the cost-effectiveness of an alternative POI substituting videotape and CBT under best-case (low-cost) and worst-case (high-cost) assumptions, identifying startup costs and break-even times.

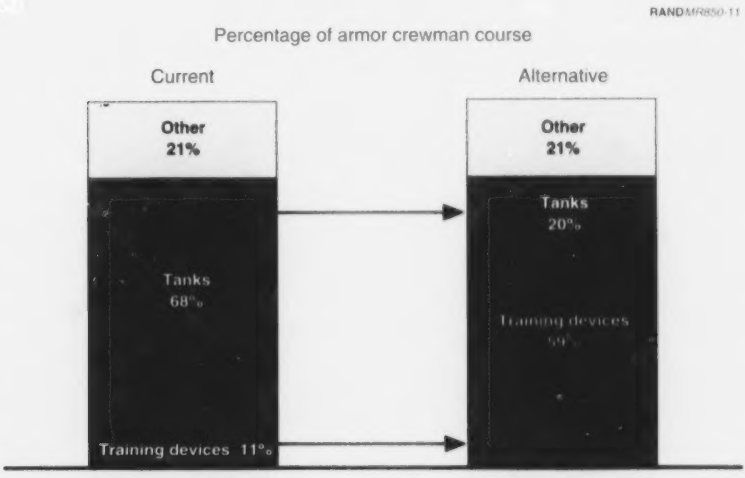
Research results. Based on the job analysis, the study suggested that a substantial number of tasks currently taught with equipment could be taught using TADSS. Specifically, as shown in Figure 11, which presents the current POI side by side with an alternative POI,[19] the current course made minimal use of training technology—in this case, a driver simulator that accounted for 11 percent of current course hours. The alternative course permitted a more than fivefold increase in TADSS training time from current levels (from 11 percent to 59 percent), accompanied by a substantial reduction in tank usage (from 68 percent to 20 percent of current course hours).[20] As the

[19]For this analysis, researchers developed one initial alternative POI that expanded the use of TADSS in MOS 19K OSUT. The current POI was used because course managers expected to continue their current use of TADSS in the foreseeable future. Clearly, other training devices could lie either between or outside these alternatives, with corresponding impacts on training effectiveness and costs.

[20]For similar results in a different branch, see Hilary Farris et al., *Computer-Based Training of Cannon Fire Direction Specialists*, Santa Monica, CA: RAND, MR-120-A, 1993. For example, the job analysis conducted for cannon fire direction specialists

figure shows, the training technologies did not *replace* the tank entirely; instead, their relative usage changed.

In terms of what TADSS were used, current driver's trainer wood mockups could be refurbished to permit more extensive training of driver's controls and starting and stopping procedures. In addition, a turret trainer could permit loaders and gunners skills now trained using a tank. Also, a driver's training vehicle—essentially a modified tank hull—could be developed or purchased. This trainer would support driver's training in the field and would support recovery and towing like vehicles and hull maintenance training, without requiring a tank. Finally, use of the programmed driver's simulator could replicate the driving experience in a variety of conditions.



SOURCE: J. D. Winkler, *Improving Training at School and Work: Lessons from RAND Research on Army Individual Training*, Santa Monica, CA: RAND, DB-144-A, 1995.

Figure 11—Comparison of Current and Alternative MOS 19K OSUT POIs

revealed that whereas the current POI heavily depends on hands-on equipment (86 percent of the current course hours), an alternative POI could reduce the need for hands-on equipment by more than half (to 38 percent) by adding a large piece of CBT (31 percent).

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As was true for the AOAC study, this study formulated a series of best-case (low-cost) and worst-case (high-cost) assumptions for the delivery, development, and training support functions. These are shown in Table 3.

The cost analysis revealed that considerable savings would occur under both sets of assumptions, with the main sources of those savings coming from reductions in expenditures for fuel and repair parts and from decreases in costs associated with setup, teardown, and maintenance of equipment, as compared to the training devices that replace them.

However, the key finding (as shown in Figure 12) was that the amount of costs and savings is driven by differences in the delivery function—in other words, on how the devices were obtained. If the devices had to be developed from scratch, the research estimated that startup costs of $20 million would return $16 million in the initial five-year period. The payback period was approximately six years. Given the life cycle of the Abrams tank, this would probably be a worthwhile investment.

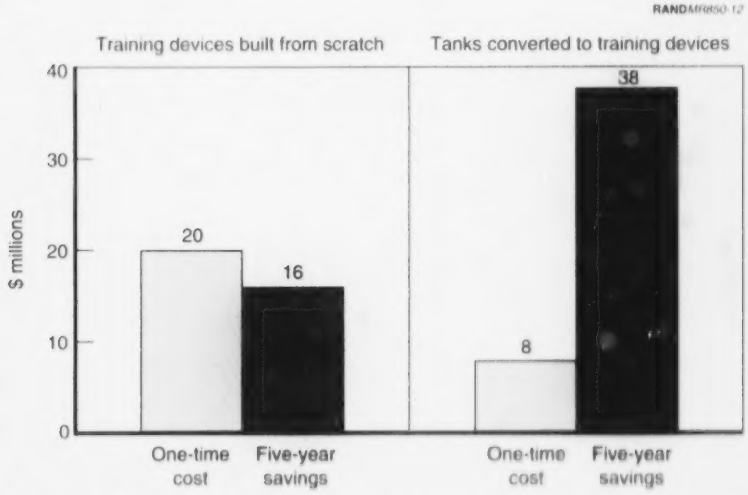
Table 3

Assumptions Used in Cost Analysis for Armor Crewmen Training Options

		Assumptions	
Training Functions	Resources/ Activities	Low Cost	High Cost
Delivery	Facilities and equipment	Surplus retrofitted; no TDA tank increase	Surplus tanks transferred; TDA tank increase
	Training time	15% TADSS time savings	No savings
Development	Product development	TRADOC standard	Hourly rates
		Basic training development costs spread	Basic training development costs not spread
Support	Logistics and maintenance	Low	High

SOURCE: J. D. Winkler, *Improving Training at School and Work: Lessons from RAND Research on Army Individual Training*, Santa Monica, CA: RAND, DB-144-A, 1995.

But if the devices were adapted from existing tanks, by converting the tanks in inventory at Fort Knox into turret trainers and hull driver trainer vehicles, startup costs of $8 million would return $38 million in savings in five years, representing savings in tank operating costs and maintenance. This program would take two years to break even.[21] The resulting savings would benefit the Army, given the life cycle of the Abrams tank in relation to the payback period for the new training devices.[22]



SOURCE: J. D. Winkler, *Improving Training at School and Work: Lessons from RAND Research on Army Individual Training*, Santa Monica, CA: RAND, DB-144-A, 1995.

Figure 12—Comparison of Armor Crewmen Course Training Costs and Savings Based on Where TADSS Are Obtained

[21]Incidentally, converting tanks to training devices is not as radical an idea as it may appear. This was done with the earlier-generation M60 tanks.

[22]Substituting TADSS for equipment can maintain training effectiveness and, in certain circumstances, permit reductions in training time and manpower requirements. See John D. Winkler and J. Michael Polich, *Effectiveness of Interactive Videodisc in Army Communications Training*, Santa Monica, CA: RAND, R-3848-FMP, January 1990.

Effectiveness of IVD in Army Communications Training[23]

Research context. To deal with the pressures of constrained training budgets, shortages of equipment available for training, and diminished means for ensuring standardized, high-quality training, training organizations began employing new computer-based training devices and simulators. Using visual, interactive, and flexible presentation methods, such technologies could simulate a variety of expensive equipment and place learners in dynamic problem-solving situations, frequently with greater facility and less cost than existing training methods.

One device that received such interest was interactive videodisc (IVD) technology, which coupled the interactive capability of the microcomputer with the high-fidelity visual capability of the laser videodisc. More specifically, IVD technology consisted of an integrated microcomputer, video display, laser videodisc, and instructional software (termed interactive software).[24]

The U.S. Army Signal Center at Fort Gordon, Georgia, pioneered the use of IVD systems for training soldiers in a variety of communications-electronics MOSs. Signal Center developers of IVD systems hypothesized that school-based IVD training might increase student proficiency and reduce hands-on training requirements for a broad range of specialties. More generally, by using visual, interactive, and flexible presentation methods, IVDs could simulate a variety of expensive equipment, place learners in dynamic problem-solving situations, and provide individualized training and feedback.

However, such training technologies could be expensive and of uncertain training value, and few had been subjected to rigorous evaluation. Equally important, there was no commonly accepted method for determining the benefits of alternative training devices for military training.

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[23]The discussion in this subsection is drawn from John D. Winkler and J. Michael Polich, *Effectiveness of Interactive Videodisc in Army Communications Training*, Santa Monica, CA: RAND, R-3848-FMP, January 1990.

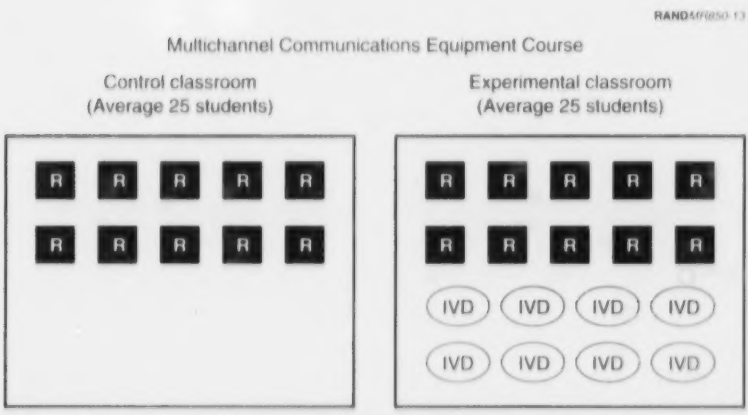
[24]IVD technology has been superseded more recently by CD-ROM technology, which has similar operating characteristics.

Research approach. This study examined two common applications of IVD in communications courses at the Army Signal Center, with the intent of developing a methodology for assessing the benefits of innovative training technologies, of applying it to evaluate the effectiveness of IVD training systems used at the Signal Center, and of defining general conditions for effective use of IVD technology.

The IVD applications were conducted in initial training courses for two "high-tech" occupations: MOS 31M, Multichannel Communications Equipment Operator; and MOS 31Q, Tactical Satellite/Microwave Systems Operator. The two studies examined two contrasting strategies for using training technology. The experiment in the MOS 31M course evaluated how IVD affected student proficiency when it was used as a device to *supplement* (enhance) hands-on equipment training by adding technologies to existing resources. This use of IVD increases training opportunity while increasing costs. The experiment in the MOS 31Q course examined the effects of using IVD to *substitute* for hands-on training with more expensive training resources. This use of IVD can maintain existing training opportunity while decreasing equipment costs.

Supplementary training with IVD: MOS 31M. This experiment took place during two weeks of the course when students learned to install "low-capacity" radio equipment. The experiment lasted seven months and covered 428 active-duty trainees who were assigned to one of two groups (classrooms), as shown in Figure 13. The "control" classroom shown on the left side of the figure represented the status quo. The classroom contained 10 multichannel radio assemblages and served 25 students, all of whom received hands-on experience with the assemblages. There was an appearance of inefficiency, because 10 students could train on the radios while the remainder worked at desks waiting for a hands-on training opportunity.

Signal School personnel had the idea that they could increase practice opportunities by obtaining and developing IVD simulations to simulate the procedures for operating the radio. The trainee used a touch pen to place cables where they belong, set meters, and so forth. The Signal School set up an "experimental" classroom alongside the control classroom. It was designed to service the same number of students (25), but it did this by using 10 radio assemblages



SOURCE: J. D. Winkler, *Improving Training at School and Work: Lessons from RAND Research on Army Individual Training*, Santa Monica, CA: RAND, DB-144-A, 1995.

Figure 13—How the IVD Enhancement Experiment Was Conducted

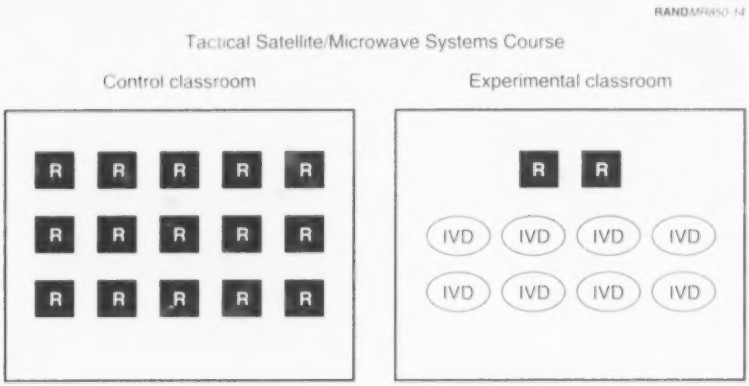
and 8 IVD devices that simulated the assemblages (as shown on the right side of the figure). Then, following the Step 4 methodology outlined in the previous section, students were randomly assigned—using a randomization and balancing model—to one or the other classrooms for training.

Several weeks later, the performance of each trainee at assemblage installation was measured using a hands-on test—in this case, the Reactive Electronic Equipment Simulator (REES), a high-fidelity, computer-controlled simulator that duplicated the face plates and actions of the tactical equipment and provided standardized, computer-monitored performance assessments for every participant. More specifically, the REES computer provided data on the accuracy with which trainees accomplished the installation, as well as the amount of time and effort required to successfully install the radio assemblage. Trainees' job knowledge was also assessed using a written examination, which contained elements of job knowledge that were trained as well as measures of trainees' attitudes toward the training they received.

Substitution training with IVD: MOS 31Q. This experiment, lasting 10 months and encompassing 336 trainees, focused on training the alignment and adjustment of complex and expensive tropospheric scatter (TROPO) radio assemblages. The approach held the amount of training opportunity constant while varying the mix of resources used for the training. Students were again randomly assigned to one of two classrooms (as shown in Figure 14).

The "control" classroom (shown on the left side of the figure) trained in the standard method, using a room equipped with 15 radio assemblages. The "experimental" classroom carried out similar exercises in a classroom that contained only two radio assemblages but had eight IVD units (as shown on the right side of the figure).

The notable feature here was that the experimental classroom was much less costly than the control classroom—by a factor of five in the costs of the radio versus the radio/IVD mixture. It also turned out that running the radio/IVD classroom required fewer instructors, by a factor of two, since less over-the-shoulder supervision was needed to use the radio/IVD mix.



SOURCE: J. D. Winkler, *Improving Training at School and Work: Lessons from RAND Research on Army Individual Training*, Santa Monica, CA: RAND, DB-144-A, 1995.

Figure 14—How the IVD Substitution Experiment Was Conducted

Immediately after the training, researchers assessed the performance of each trainee using a hands-on test based on the Army Soldier's Manual, including three relevant tasks (intermediate frequency (IF) gain alignment, automatic gain control (AGC) alignment, and squelch adjustment). The hands-on tests were administered by objective assessors who were unaware of how each soldier had been trained. For each test, researchers determined whether the trainee could accomplish each of the tasks with the respective Army time standard and recorded errors made during task performance. Trainees also received a written test providing measures of task knowledge and attitudes toward the training they received.

Research results. The research hypothesis in the *supplementary* training experiment in the MOS 31M course was that IVD use would increase the efficiency of training while improving student proficiency. Based on the analysis, the researchers determined that the IVDs were well-accepted by instructors and that student time available for practice was used more efficiently in the experimental group. Both groups spent the same amount of time in the classroom (about 40 hours per week). The experimental classroom, however, permitted a 45 percent increase in exercise time within a constraint of constant student time.

However, the results were a bit more disappointing for improving student proficiency. Regression analyses showed that the supplementary IVD training provided to the experimental classroom caused statistically significant reductions in the time needed to install the radio equipment, the number of trials (amount of effort) needed to accomplish the installation, and the likelihood of a student error during the installation process. However, the reductions for the three tasks were modest—11, 15, and 15 percent, respectively.

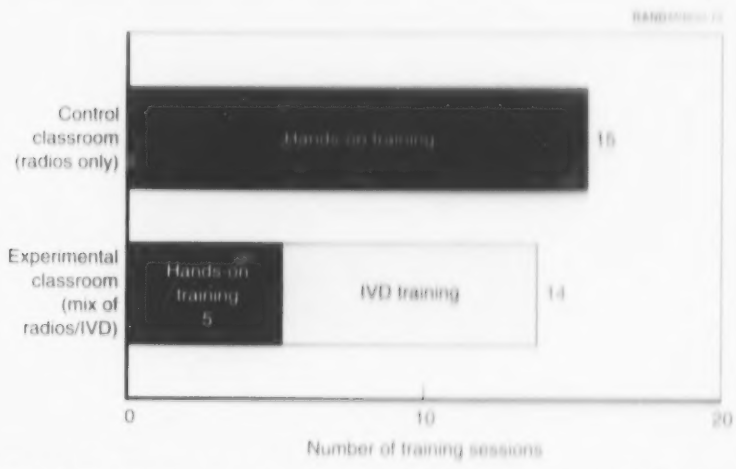
Apparently, proficiency seemed adequate to begin with, with both classrooms proving very proficient at meeting the military standard: 96 percent of the trainees eventually got the task right in the allotted time. It seemed that initial proficiency should have been taken into account before adding resources to classrooms. Even though there were only 10 radios and 25 students, practice time was adequate.

The research hypothesis in the *substitution* training experiment in MOS 31Q course was that students would be equally proficient at the

tasks, whether they trained under the traditional equipment-only regimen or under the alternative regimen in which IVD was used at a substantial savings in training resources.

As Figure 15 shows, despite the resource substitution, the students received roughly equivalent training in the two conditions. The figure shows the number of "practice sessions" received by the students in the two classrooms. Each session covered a number of procedures needed to install and operate TRQPQ radios. Students in the control classroom received about 15 sessions in which to practice the tasks. Students in the experimental classroom received 14 sessions on average in which to practice the task, 9 of which occurred on IVD.

Figure 16 shows how the students in the two classrooms performed on hands-on tests of three tasks covered in the practice sessions using radios or the radio/IVD mixture—IF gain alignment, AGC alignment, and squelch adjustment. The two groups were statistically indistinguishable, particularly on the most difficult of the tasks—the

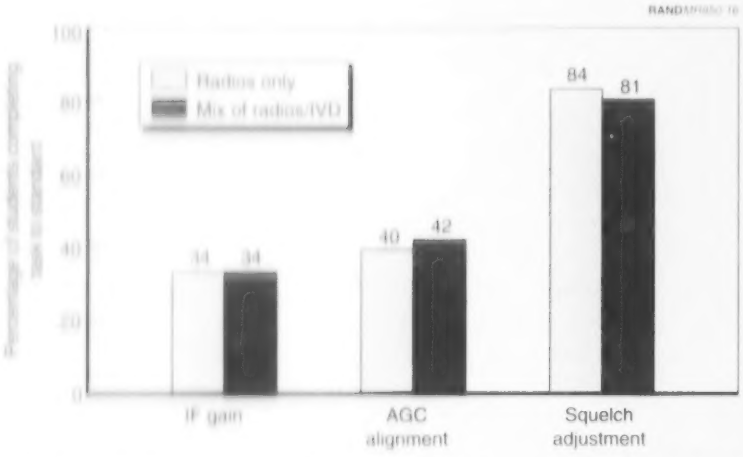


SOURCE: J. D. Winkler, *Improving Training at School and Work: Lessons from RAND Research on Army Individual Training*, Santa Monica, CA: RAND, DB-144-A, 1995.

Figure 15—Comparison of Training Time in Control and Experimental Classrooms for IVD Substitution Experiment

IF gain alignment. Both groups were equally able to perform the tasks to Army standard. Performance was not all that high in all cases, but it did not matter whether the students were trained using equipment or a mix of equipment and simulation.

The results of both experiments indicated that IVD could be an effective element of training and that there were conditions for using the technology wisely. However, given that proficiency was not dramatically affected in either application and given the costs of acquiring IVD systems and developing supporting interactive courseware, the studies suggested that defense managers should give priority to those IVD applications that could save training costs as part of a training resource mix. Further, the results argued that in applications designed to improve proficiency at added cost, the burden of proof should fall on the IVD proponent to show that improvement is needed and worth the cost.



SOURCE: J. D. Winkler, *Improving Training at School and Work: Lessons from RAND Research on Army Individual Training*, Santa Monica, CA: RAND, DB-144-A, 1995

Figure 16—Comparison of Performance on Tasks in Control and Experimental Classrooms for IVD Substitution Experiment

Collective Training—Simulations for Large-Scale Exercises[25]

Research context. Traditionally, the Army has favored large-scale, multiechelon field exercises that involve maneuvering substantial numbers of combat units and their support elements against a similarly equipped opponent. Three reasons stand out: (1) they provide the best approximations to actual combat (realism); (2) they use resources efficiently; and (3) they reflect national capability and commitment. REFORGER (Return of Forces to Germany) was probably the best-known example, but other exercises, such as Caravan Guard conducted by V Corps in Germany, share many characteristics with REFORGER.

Despite their benefits, traditional exercises are facing increasing constraints, especially in terms of decreasing resources. Field exercises have become expensive, in both operating costs and maneuver damage costs. Modern weapon systems (such as the Apache and M-1A1) that depend on high-technology components simply cost more to operate. Also, cost inflation and environmental constraints have increased the difficulty of conducting large-scale maneuver exercises.

These constraints led the Army to test alternative exercise modes—both field exercises and simulations—to determine which combination worked best for providing effective collective training while adjusting to lower resource levels. RAND researchers observed the use of simulations in collective training exercises and described issues associated with their implementation and use.

Research approach. The goal of RAND researchers was to observe and assess the use of the exercises in REFORGER (in this case, Centurion Shield 1990 (CS 90) and Caravan Guard 1989 (CG 89)). Four exercise modes formed the building blocks of the two experimental exercises. Both exercises retained a sizable field training exercise (FTX), which consisted of full units maneuvering with all their assigned equipment and personnel in the field. But both exercises also employed a command field exercise (CFX), a command post exercise

[25]The discussion in this subsection is drawn from Patrick D. Allen, *Simulation Support of Large-Scale Exercises: A REFORGER Case Study*, Santa Monica, CA: RAND, R-4156-A, 1992; and Patrick D. Allen et al., *Observations of the Caravan Guard 89 Exercise*, Santa Monica, CA: RAND, N-3151-A, 1992.

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(CPX), and a computer-assisted exercise (CAX) to determine whether a different mode or combination of modes would alleviate some of the cost and maneuver restrictions and still provide good training benefit. The CFX consisted of command vehicles only, such as the tank platoon leader or even tank company leader, reducing the number of personnel and vehicles in the field. The CPX consisted of only the command and staff elements of the participating units, such as battalions and above. Finally, the CAX consisted of any exercise that employed a computer to assist in assessing the outcomes. CAX exercises ranged anywhere from a relatively simple program run on a personal computer to more elaborate groups of models run simultaneously on a network of computers.

Two examples of frequently employed CAX—and, indeed, the two used in CS 90 and CG 89—were the Battle Command Training Program (BCTP) (and the Corps Battle Simulation (CBS) used in it) and the Warrior Preparation Center (WPC).[26] Briefly, the BCTP warfighter was the first systematic approach to training a higher echelon (either a corps or division headquarters) with a set of measurable standards for specific functional areas. The BCTP consisted of two parts: the seminar wargame used to build the team and achieve a common understanding of how doctrine applies to unit tasks, and the warfighter exercise, which was a training event conducted several months after the seminar exercise. The WPC was a training support facility funded and manned by the U.S. Army Europe and U.S. Air Forces in Europe. The WPC had a large suite of computers and simulations that were used to exercise both air and ground forces interactively. Exercises were two-sided, with a reactive, thinking opponent or threat cell, and they usually involved multiple echelons and many functional areas.

Figure 17 shows how the training modes were configured during CG 89, which took place on 13–20 September 1989. On the ground, each side had one live division in either FTX or CFX mode. One flank was

[26]For more information on the BCTP, see James P. Kahan et al., *Implementing the Battle Command Training Program*, RAND, R-3816-A, August 1989; for more information on the WPC, see P. D. Allen, *Evolution of Models at the Warrior Preparation Center: Problems and Solutions for Higher-Echelon Exercises*, Santa Monica, CA: RAND, R-4155-AF/A, 1993.

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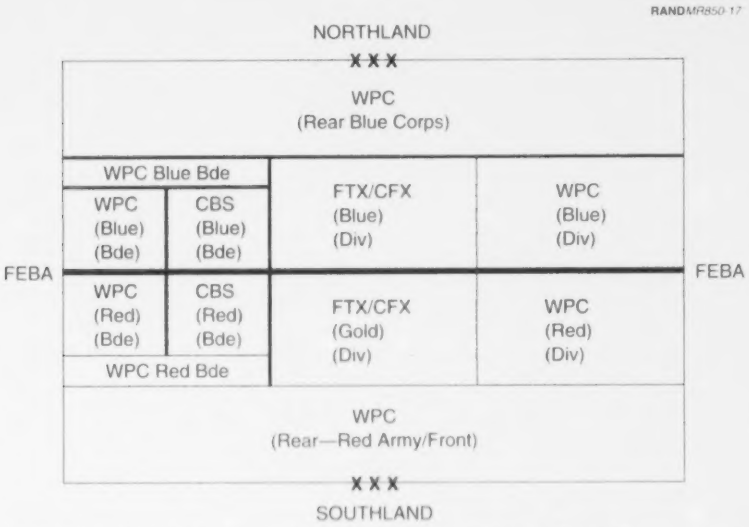

SOURCE: Patrick D. Allen, *Simulation Support of Large-Scale Exercises: A REFORGER Case Study*, Santa Monica, CA: RAND, R-4156-A, 1992.

Figure 17—Exercise Battlefield for Caravan Guard 89

simulated at brigade level using CBS, with scout platoons to provide the interface with the live portion of the exercise. The other flank and the deep and rear battles for all units (both live and simulated) were simulated at the WPC.

Research results. The research provided strong evidence that simulations were effective for conducting collective training at all levels. At the crew and small-unit level, simulations could improve gunnery performance in armored vehicles while replacing some more expensive live-fire training. At higher levels, simulations were useful for exercising command groups and staffs, alone and when combined with a field training exercise (FTX) to improve the quality of training while simultaneously reducing training costs. In fact, simulation-supported exercises might provide more benefit than traditional

FTXs for certain functional areas (e.g., intelligence and deep battle cells of command staffs). Simulations, with selected command elements in the field, could be a primary training mode and might be preferable to "pure" FTXs for echelons above the battalion.

At the same time, the studies indicated that the technical quality of simulations needed improvement, especially as they combine with traditional forms of training. In many instances, the appropriate level of fidelity and degree of substitution had not been determined.

Quantitative evidence was sparse about the resources, costs, and tradeoffs associated with the expanded use of simulations. Although expenses associated with maneuver damage and consumables declined, simulations brought added costs for communication and support personnel, especially in the advanced communications required to distribute the simulations to remote sites. At the same time, however, there was initial evidence that other training devices and simulators, such as the Army's Conduct of Fire Trainer (COFT, a gunnery training device) and Simulation Networking system (SIMNET, a networked armored vehicle maneuver training system), might be capable of substituting for some live-fire and maneuver training.[27]

Overall, the evidence showed that simulations held promise for preserving effectiveness and lowering the costs of collective training, but further evaluation was needed.

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[27]See, for example, Richard E. Brown, Robert G. Pishel, and Lounell D. Southard, *Simulation Networking: Preliminary Training Developments Study*, White Sands Missile Range, NM: U.S. Army TRADOC Analysis Command, TRAC-WSMR-TEA-8-88, April 1988; Walter G. Butler, *Training Developments Study—Bradley Fighting Vehicle Unit-Conduct of Fire Trainer*, White Sands Missile Range, NM: U.S. Army TRADOC Systems Analysis Activity, TRASANA-TEA-28-82, April 1982; Walter G. Butler and Charles R. Hughes, *Study Summary: M1 Unit-Conduct of Fire Trainer: Post Fielding Training Effectiveness Analysis*, White Sands Missile Range, NM: U.S. Army TRADOC Systems Analysis Activity, ACN 67571, April 1987; and Charles R. Hughes et al., *M1 Unit Conduct-of-Fire Trainer: Post Fielding Training Effectiveness Analysis*, White Sands Missile Range, NM: U.S. Army TRADOC Analysis Command, TRAC-WSMR-TEA-16-87, April 1987.

CONSOLIDATION OF TRAINING INSTITUTIONS[28]

Research Context

In a recent study, Arroyo Center researchers have examined resources and costs associated with a U.S. Army initiative to restructure and consolidate schools providing individual training in the Reserve Components.[29] As part of this assessment, the researchers analyzed links between resources, costs, and efficiency of training in RC schools, and they suggested a number of ways to improve the efficiency of the school system (e.g., through measures that improve use of training capacity and manpower and further consolidation).

The impetus toward restructuring was motivated in part by concerns that the existing school system offered courses at too many locations, which duplicated effort and wasted resources. Hence, part of the restructuring initiative involved organizing training on a regional basis (i.e., dividing the nation into eight regions for managing RC schools), reducing the number of separate school organizations, and decreasing the span of course offerings in given schools (by specializing their missions), thereby gaining economies of scale. On top of this was overlaid a related effort by the Army National Guard (ARNG) to create "superregional" sites for training in specific career fields in a handful of locations throughout the nation. However, despite the promise of consolidation, there was concern about the effect that training-site consolidation would have on training costs, particularly travel. Fewer training sites mean longer travel distances for students and instructors and, therefore, higher travel costs, which can offset or even exceed any gains in savings from consolidation.

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[28]This discussion is drawn from Michael Shanley, John D. Winkler, and Paul Steinberg, *Resources, Costs, and Efficiency of Training in the Total Army School System*, Santa Monica, CA: RAND, MR-844-A, 1997, and John D. Winkler et al., *Assessing the Performance of the Army Reserve Components School System*, Santa Monica, CA: RAND, MR-590-A, 1996.

[29]These schools, known as Reserve Component Training Institutions (RCTI), offer (among other courses) reclassification training to prior-service personnel to qualify them for their duty MOS and leadership training to Reserve Component officers and NCOs.

Research Approach

This tradeoff relationship between support costs and travel costs can be captured by what is, in most situations, a U-shaped total cost curve, where total cost is defined as the sum of travel costs and support costs per student. The total cost curve—the measure of efficiency—shows that higher costs (and lower efficiency) occur with either too many or too few sites, and that minimum cost (and maximum efficiency) is obtained by using a middle number of training locations—one that balances travel and support cost.

To model the tradeoff between manpower support costs and travel costs, researchers did four things. First, they converted training support days into dollars so they could be compared to travel costs, using factors obtained from the Army's Cost and Economic Analysis Center (CEAC) that estimate pay and benefits of instructors and school support staff.

Second, to estimate training support manpower costs as a function of the number of locations, researchers drew on the results of visits to annual training (AT) sites offering individual training, where they documented the support manpower used and obtained school managers' estimates on how that number would change for alternative-sized and sequentially run ATs. Larger ATs were typically predicted to realize large savings in support; for example, increasing the size of the AT by 50 percent would often only require about a 5 percent increase in support manpower. Sequential ATs, where setup and closedown costs could be avoided, yielded significant but much more modest efficiencies. When modeling the reduction of support costs per student day as a function of the reduction in the number of sites, the researchers assumed gaining sites would expand by using a combination of larger training sessions and a greater number of sequential training sessions.

Third, to estimate the distance traveled by students and instructors as a function of the number of locations, researchers began with the current number of locations at which a course or set of courses was taught and the average distances traveled by instructors and students. To estimate the distance students would travel if the number

of sites were higher or lower, they employed a mathematical formula that related the number of sites and distance. The formula stated that after a change, the new average distance would equal the old distance times the ratio of the original number of sites to the new number of sites. Thus, if the original number of locations was eight, the average distance traveled would double at four locations (half the original number), and double again at two locations (half again the number of locations).[30]

Finally, to calculate the cost of travel, researchers assumed 30 cents per mile as the amount the military would have to pay for additional travel generated by a reduction in the number of training sites. To obtain a basis for this estimate, they used the Army Reserve's financial data base to collect actual payments in various regions of the nation.

Research Results

In conducting the analysis, researchers found that having less than one AT training location per region for a course (the ARNG plan for superregional training sites) was most efficient when support costs were high, such as they were for combat arms (CA) courses.

Figure 18 illustrates the results for one such AT course—11M (mechanized infantryman). The y-axis represents the cost per student per AT, the x-axis the number of training sites. The middle curve shows the decreasing cost of support on a per-student basis as the number of training sites decreases, allowing more focused support and more students per AT. While that cost was nearly $900 per student with eight training sites (corresponding to one site per region), it decreased to less than $600 per student if all training could be consolidated to one site. In contrast, the lowest curve shows the increasing cost of travel as the number of sites decreases. While that cost averaged only $180 with eight locations (average one-way distance 300 miles), it increased to $450 per student with one location

[30]In using this formula, researchers had to first adjust for crossovers—personnel who "crossed over" the class closest to them to attend a class at a more distant site (presumably for the schedule convenience). They assumed that as the number of sites decreased, the proportion of crossover would decrease. This adjustment flattened the travel cost curve, but it turned out to be insensitive to the conclusions of the analyses.

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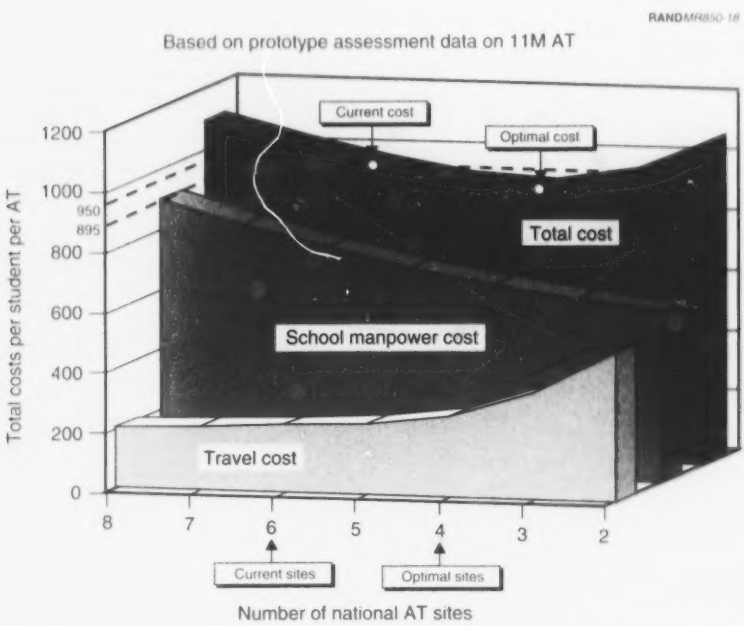
(average one-way distance 750 miles). The highest curve is the total U-shaped cost curve, which at each point shows the sum of travel and support cost. The curve shows that higher costs occurred with either too large or too small a number of sites. The lowest point along the curve was at about four sites, which implied about one site for every two regions of the nation.

Just how much could be saved by consolidating training sites depended on the starting point. If the current number of sites was far from the optimal number, high savings were possible; but if the current number was equal to the optimum, no savings were possible. In



SOURCE: Michael Shanley, John D. Winkler, and Paul Steinberg, *Resources, Costs, and Efficiency of Training in the Total Army School System*, Santa Monica, CA: RAND, MR-844-A, 1997.

Figure 18—Consolidating AT Sites Can Provide Further Efficiency Gains

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the case of the 11M AT example, modest savings derived from consolidation. The figure shows the current number of 11M AT sites (six) in fiscal year 1995; it would appear possible to reduce the number of AT locations to about four (in the middle of the U-shaped curve, as shown on the figure). Such a consolidation would achieve about 7 percent savings (reducing the total cost from $950 to $895 per student, as shown in the horizontal dotted lines in the figure). Reducing beyond four sites would cause travel costs to escalate much faster than it would cause support costs to fall and, thus, would lead to another less-than-optimal situation.

There might be other such courses where the number of training locations could be reduced to improve efficiency and reduce the total cost of training. For example, researchers found that selected artillery courses required more than twice the support of the 11M AT. However, the opposite conclusion held for those courses where support costs were low (e.g., in personnel administration MOSs and for much weekend training in the RC). Hence, the amount of resources devoted to training support was a key factor guiding the probable success of consolidation initiatives that seek to reduce the number of training locations. In fact, where support costs were low, multiple training locations might well be the least-cost option.

Chapter Four

IMPLICATIONS

The research discussed in the previous chapter identifies key issues for guiding initiatives that seek to restructure military education and training. This chapter draws on and extends these research issues to suggest directions that such initiatives might take to best achieve resource savings and additional benefits.

CONSOLIDATION

Taken together, the research results demonstrate that initiatives that consolidate training programs (e.g., by combining military occupations, courses, and schools) can provide savings in manpower and other resources devoted to training. And given the large number of separate training courses and locations across the military services, the potential for consolidation seems large. However, the extent of savings will depend on two key factors:

- The resource intensity of the activities, especially the amount of support manpower required to conduct them.
- The amount of "real" versus "perceived" redundancy inherent in the different occupations, courses, and schools.

Without sufficient duplication and resources, savings are not likely to be large enough or realized quickly enough to offset the costs of consolidation. For example, as shown in the analysis of intraservice consolidation in RC schools, if training support—a chief source of savings from consolidation—is minimal in the first place, then consolidating dispersed training sites to a smaller number of locations

may not yield enough savings to offset increased travel costs and make the consolidation worthwhile.

It is also important to avoid consolidations based on superficial similarities. Many interservice consolidation initiatives will founder on this score (e.g., training all cooks in one service because all services employ cooks). In general, the possibilities for consolidating training courses between the military services is limited because of differences in the content of a training program (e.g., because of differences in doctrine and equipment). However, intraservice initiatives remain to be pursued, especially where duplication remains on a national and regional basis and between the AC and the RC.

The research also indicates that it is possible to go too far in consolidating training programs. Consolidation often represents a tradeoff: One seeks a reduction in costs (frequently in manpower and support resources), but this can be offset by an increase in other costs (e.g., in travel costs to bring soldiers to training). As the analysis of consolidation in RC schools indicates, an optimum solution often occurs at the midpoint of a U-shaped cost curve, where the savings and the costs are balanced. With too much consolidation, costs may overcome the savings. Hence, it is important to balance student densities and the geographic location of students and training facilities in determining the optimum number of separate training locations. Similar tradeoffs exist in considering other forms of consolidation.

Moreover, this tradeoff may not always be purely monetary. As the AMI example shows, the savings of consolidation (in this case from combining MOSs) might be offset not only by increased costs but also by a reduction in individual and unit capability that may be unacceptable to military planners. In any case, the tradeoffs must be articulated clearly and completely to permit an informed decision about what may be needed or lost to achieve desired savings.

DISTRIBUTION AND OUTSOURCING

Occasionally, an initiative that seeks to reduce costs and conserve training resources will realign responsibilities and functions: move training from one location to another (e.g., schoolhouse to home station), change training methods (e.g., use simulation in lieu of maneuver training), or substitute one set of resources for another (e.g.,

use civilian training resources in lieu of military ones). From a cost perspective, the success of these initiatives will often rest on the size of the investment needed, recurring costs (especially as these "ripple" through the system that is affected), recurring savings, and the time required to achieve the payback. The research suggests that restructuring will be most successful when it is accomplished under the following conditions:

- When reducing resources in one part of the training system does not require offsetting increases in other organizations (i.e., new manpower, equipment, and facilities to execute and support the restructured program).
- Where the doctrine and the material trained and technology used are more likely to remain stable, which minimizes recurring costs and increases the prospects of recouping the investment. Such conditions are more likely, for example, where the skills being trained are less complex, the tasks to be performed are less likely to change, and the equipment life cycles are longer.
- Where infrastructure made superfluous by restructuring is removed from inventory.

The first of these conditions is likely to be violated when savings are presumed from initiatives that merely reduce the length of existing training programs by reducing the material taught, as opposed to teaching the same material faster. Such initiatives often do not acknowledge the costs or risks that are being transferred in this fashion. They may assume the capability to take on additional training burden, which may or may not exist. Moreover, if there are savings to be had, they may be limited. While some unnecessary training or overtraining may occur, in the analyses reported here, the amount appears small. In addition, suitable replacement topics often exist to fill the time that may be freed up or to replace the topics deemed unnecessary. Hence, efforts to reduce the length of training often yield illusory savings because they do not recognize existing deficits in the content of training programs.

Outsourcing, which substitutes civilian resources for military and governmental ones in delivering training, is a special case of restructuring. Substituting civilian resources, for example, by using civilian vocational, technical, and postsecondary institutions, or through

contract training services at military facilities, may allow resources now used to conduct training to be reduced or eliminated.[1] As such, we believe privatization is also subject to the conditions defined above. In particular, the third of these conditions is especially important: To the degree that civilian resources are substituted, they must truly replace military resources; otherwise, cost savings are unlikely.[2]

As discussed previously, analyses have not adequately explored the feasibility and potential benefits of outsourcing as part of military training.[3] The services currently use contract training in selected areas, but the practice is not widespread. Outsourcing holds promise for lowering costs and improving efficiency of training, but further evaluation is needed.[4]

MAKING APPROPRIATE USE OF TRAINING TECHNOLOGY

The studies discussed above hold important insights about the role technology may play in initiatives for restructuring and consolidating training programs. The lessons are mixed; clearly, there are situations under which training technology may play an important role in improving training of individual and collective skills. But there are also situations in which technology might not achieve its intended benefits.

On the positive side, results demonstrate that there is considerable room to expand the use of technologies to preserve effectiveness and reduce resources devoted to training. The clearest case involves the schoolhouse, where the research supports the expanded use of CBT

[1]Note that this logic also argues for the expanded use of lateral-entry programs that give credit for education or employment experiences (such as the Army's Civilian Acquired Skills Training Program), since these may also lessen training time for military personnel and thereby permit a reduction in training resources.

[2]An example would be retaining military instructors to supervise civilian contract trainers.

[3]There are, of course, a number of issues related to privatization and outsourcing in the military; these are beyond the scope of this document. For a more detailed discussion, see Frank Camm, "Privatizing Defense Support Services: A White Paper," Santa Monica, CA: RAND, PM-267-CRMAF, 1995.

[4]Also, as will be discussed later, it may be particularly beneficial for reducing costs and improving efficiency of training support and training development.

systems and TADSS. The potential benefits include improvements in training quality, potentially with greater efficiency and with less cost than by using existing training methods. However, the research also shows that the savings are more likely to be achieved, and the improvements in training quality more easily justified, when technology is used to *substitute* for more expensive capital or labor (e.g., to replace existing equipment and facilities) rather than to *enhance* existing resources. In the same vein, the research suggests that technology in schoolhouses may prove particularly beneficial when it increases productive capacity and lowers requirements for training and support personnel.

The research is more cautionary, however, when it comes to restructuring initiatives that seek savings by relying on training technologies to provide "distance education." Here, the research highlights not only the costs and risks of shifting the training burden from schools to units and soldiers (discussed above), but also the recurring costs of supporting these systems and the investment risks associated with them. Hence, when it comes to distance education, the research recommends, for the most part, building on existing weapons and training platforms and using "off-the-shelf" technologies that have lower investment and support costs and that are less likely to become obsolete. This argues, for example, for developing software to run on commercially available hardware, rather than acquiring hardware with unique specifications. It also argues for capitalizing on existing telecommunications networks, as opposed to developing and maintaining new systems and networks, and it suggests that lower-cost systems (e.g., relying on electronic mail and the Internet) may be preferable to higher-cost systems (e.g., using teleconferencing to deliver training).

Another important lesson from research on training technology is the need to analyze the *uses* to which training technologies are put to accomplish resource savings and improve training efficiency. As the DoD and the services rely increasingly on training technology in individual and unit-level training programs, they need analytically sound criteria for determining which applications of training technology are most appropriate and effective, along with a strategy for selecting high-priority applications among many competing alternatives in the schoolhouse and in the field. Unfortunately, current techniques used to identify training deficiencies, which provide the

basis for training technology resources, often rely on data of uncertain reliability and validity. As a result, decisions are made in the absence of systematic data that assess performance problems in units and how well service members actually perform in their jobs.

To ensure that restructuring initiatives that rely on training technologies accomplish their intended objectives, improved methods and procedures are needed that

- Define technologies and distinguish applications;
- Establish needs, set priorities, and select and reject potential applications;
- Define criteria for making training technology investments (e.g., based on considerations of costs and effectiveness);
- Provide objective, quantifiable measures of these criteria to guide decisionmaking.

Criteria and measures for guiding training technology investment decisions are illustrated in Tables 4 and 5, respectively. Table 4 distinguishes two types of training technology applications. The first provides cost savings in manpower, equipment acquisition, operating costs, maintenance costs, and facility utilization and related expenses. In these cases, training technologies usually *replace* existing training, as part of a resource mix.

The second, more encompassing category is applications that *may* prove cost-effective. The cost-effectiveness depends on the relative scarcity of training opportunity or on the extent that proficiency is demonstrably unsatisfactory. Potentially cost-effective applications also include using training technologies where benefits will actually be achieved by increased efficiency (e.g., by making more "productive" use of time) or provide training where hands-on training is hazardous or otherwise unavailable.

As shown in Table 5, the costs and gains of such applications are demonstrable through quantitative measures. For all applications, policymakers' investment decisions can be better informed by a number of measures. For example, surveys can document how much demand there is for a training technology and how extensively it will be used. Other measures applicable to all applications of

Table 4

Criteria for Selecting Training Technologies

Type of Application	Criteria
Cost-saving	• Substitute for hands-on experience where significant resource savings are possible – Costs for equipment (acquired or replaced) – Operating expenses (e.g., fuel, ammunition) – Maintenance costs (e.g., equipment damage) – Decreased training time or TDY expenses – Personnel delivering or supporting training
Cost-effective	• Supplement existing training when there is no less costly, equally effective way to train – Where training opportunity is very scarce – Where proficiency levels or qualification rates are unsatisfactory – Where benefits will be realized by increased efficiency – Where training supports multiple training requirements (e.g., AC/RC) • Simulate experience where hands-on training is hazardous or unavailable

training technology can include the number of soldiers to be trained and the amount of training to be provided in the short term and over the life cycle of relevant equipment and doctrine (e.g., as measured in POI hours or in hours per week of use). In addition, evidence that alternative technologies and media were considered could strengthen the case for the particular application.

Beyond measures applicable to all training technologies, Table 5 shows some measures applicable for cost-saving and cost-effective applications of training technologies. In terms of cost-saving applications (which tend to be technologies that substitute for existing training), the defining attribute is that the technologies result in actual savings or true cost avoidance. If technologies are used to substitute for equipment or instructors, then either specific equipment should be eliminated from inventory, or a programmed acquisition must be averted.

Table 5

Potential Measures for Training Technologies

Type of Application	Measures
All	• Demand for product in the field (e.g., survey results) • Number of soldiers to be trained • Stability in POI and/or equipment • Rationale for selection of media and tasks
Cost-saving	• Equipment forgone and costs to be saved • Operating or maintenance costs to be saved • Reduction in training time or related expenses to be achieved • Personnel assignments to be reduced
Cost-effective	• Amount of training time now available per student (hours per week) • Current proficiency at tasks (e.g., failure rates) • Increase in efficiency to be expected (e.g., additional tasks to be taught)

Judging the potential cost-effectiveness of training technologies, which tend to *enhance* existing training, is more difficult; the cost-effectiveness of an application relies on the *relative* magnitude of the training deficiency or lack of proficiency from application to application, coupled with an accurate estimation of the anticipated costs of the application. The higher the ratio of effectiveness gained (e.g., a decrease in training deficiency or an increase in proficiency) to the cost of the application, the better. Measures that allow comparisons of training need include, for example, the amount of training time now available per student or the current failure rate at the task to be trained in the schoolhouse or as documented in the field. The more extreme deficiencies are ones for which the cost-effectiveness is likely to be greater (holding costs constant). The true cost-effectiveness, of course, can only be determined in a clinical trial or similar study.

The amount of time to be saved and the increase in efficiency to be achieved from using such applications can be documented. For example, a claim of increased efficiency can be supported by data

showing the amount of training to be added and the costs of providing the training if the course were lengthened or the training provided in an alternative forum.

IMPROVING TRAINING RESOURCE MANAGEMENT

A final set of issues derived from the research described in the previous chapter relates to calculating resource and cost savings from restructuring military training programs. In conducting these analyses, researchers have observed a number of issues that complicate such initiatives.

Problem Definition

The first issue is one of problem definition, which gets at the issue of what the goal of consolidation is. Often, the goal of consolidation is to conserve *dollar resources*. Where resources used for training are allocated in dollars, as in O&M accounts, restructuring the activities that use these dollars can result in dollar savings. However, another goal of consolidation can be to improve training *efficiency* by reducing training manpower resources (instructors, support staff, and students). The efficiency of school manpower can be improved in one of two ways: by maintaining output (trained personnel) with fewer military manpower resources, or by improving output with the same level of military manpower resources.

Frequently, consolidation and restructuring initiatives confuse these goals and, hence, set inappropriate expectations (e.g., seeking cost savings from changes that could in fact improve efficiency). Improving efficiency can be a very desirable goal for restructuring initiatives, even in the absence of cost savings.[5]

Actually, the two goals are not independent. Initiatives that restructure training—e.g., by reducing the number of military trainers and support staff or by shortening training time for students—can effect savings in time and salaries during training, but the dollar savings are limited without a net reduction in overall end strength. Without a

[5]This permits, for example, more military manpower to be allocated to line units relative to support organizations at a given end strength.

reduction in end strength, much of the military manpower savings are shifted to other organizations.[6]

Determining and Allocating Training Resources

A second issue concerns the processes now used to determine and allocate training resources. In general, the research has observed that the existing resourcing system is not well equipped to deal with "radical surgery" of training functions (e.g., reallocations, consolidations, or substitutions of training resources). Rather, it is equipped to apportion budget increases, add new functions, or even distribute across-the-board cuts. This follows from the original purpose of the training resourcing system—to manage incremental growth while enhancing readiness. While this orientation has been appropriate in the past, it has created cumbersome and inflexible systems and processes in responding to a changing environment.

The hierarchical, top-down process for determining training resources creates one set of problems. The system relies on planning documents based on doctrine and historical experience to establish resourcing standards (i.e., amounts of manpower and equipment required for a given level of workload). It estimates costs, again using historical information, and it projects budget increments or decrements based on workload changes. However, past experience provides meager guidance outside the realm of small changes in experience. Moreover, the empirical underpinnings of many resource standards are not well established, particularly for a restructured or "consolidated" training environment (e.g., necessary levels of manpower, equipment, or training time).

The current process for allocating training resources also makes it difficult to build support for restructuring or consolidating training activities. Resources are dispensed to subordinate organizations based on missions, doctrine, and requirements documents. Training and installation managers typically control only a portion of the resources, the use of which is often "fenced" or restricted. Discre-

[6]However, it is possible that some of the shifted manpower may be to positions requiring lower grades (e.g., from more senior instructors to more junior personnel in "line units"). In this case there may be military pay and allowances (MPA) savings associated with this shift.

tionary funds are few and less available farther down the hierarchy. As a result, the available resources and funding is really a set of fixed resources. The incentives encourage managers to suboptimize and protect existing resources; they do not promote systemic cost reduction innovations at the local level.

Therefore, to accomplish savings from restructuring and consolidation, the research identifies a strong need to review and revise existing resourcing assumptions, standards, and procedures for determining and allocating training resources. Resource standards, in particular, drive costs and need to be reexamined. They contain assumptions about the number and type of manpower, equipment, supplies, and so forth required to perform the various training functions and activities, as well as the time and costs needed to develop training products—assumptions that need to be verified and updated. Assumptions in need of review include:

- Ratios of instructors and equipment per student, especially as these might vary with different training methods (e.g., computer-based training versus hands-on training);
- Prerequisites and qualifications of instructors and support staff, including requirements that such personnel be military, government, or contract;
- Optimum and maximum class sizes for conducting training;
- Time allocated for class preparation and administration;
- Costs of training development;[7]
- Substitutions allowable through simulation.

Incentives for Change

Finally, there is the issue of incentives for change—providing flexibility and rewards for innovation. The potential to conserve resources and save costs is unknown but potentially large. However, the current system does not provide incentives or even the necessary

[7]For example, current standards assume that all CBT products cost the same to develop, regardless of their length.

cost and pricing information to encourage cost-reducing innovations. On the contrary, innovators who find more efficient ways of conducting their affairs are often rewarded with reduced resources. Schools may be reluctant to substitute technology for people because military instructors are a "free good." Since military pay and allowances are not associated with school budgets, they have no incentive to spend money to reduce manpower. This issue should be addressed as part of a serious attempt to restructure and consolidate the military training system.

EXPLORING OTHER PROMISING INITIATIVES

As discussed earlier, many initiatives intended to restructure and consolidate training focus on the *delivery* of specific courses. Given the scope of training programs, this is easy to understand, and opportunities likely remain to restructure and consolidate training delivery functions. However, existing consolidation initiatives are informative in what they do not often address—consolidations of training functions other than training delivery. Other promising forms of consolidation include combining other activities (e.g., training development and support) or sharing and leveraging resources across organizational boundaries. Such leveraging might be particularly suitable for joint initiatives between the military services.

Training development and training support activities provide further potential for restructuring and consolidation initiatives. For example, training development, since it involves designing, developing, and procuring instructional products and technologies, may lend itself to increased centralization along intraservice or interservice lines, even if responsibility for delivering training remains in existing institutions.[8]

Such consolidation could be quite efficient for certain curricula. For example, many occupations require similar knowledge (e.g., basic electronics theory and principles of maintenance and troubleshooting). Another is common leadership skills among NCOs or officers.

[8]Funding for training development has decreased sharply in recent years. Hence, it may be one area where consolidation can help integrate capability that is eroding rapidly.

There may be advantages to centralizing some of the design and development resources needed to create instructional systems and materials for training these topics in schools and units.[9]

Combining and sharing training support activities may also provide economies and efficiencies. For example, the distribution of training products (e.g., programs of instruction (POIs), instructor and student guides, field manuals, technical manuals, and other reference material) might be done faster and at lower cost by a single agency using up-to-date transmission technology.[10] Other examples might include:

- Developing common standards and establishing shared systems for training technologies (e.g., production and transmission facilities for distance education programs);
- Collocating training programs conducted by different services or branches at a single installation to improve scale economies in using available facilities.

Additional possibilities may also exist for restructuring and consolidating collective training now conducted in institutions and units. Such initiatives, for example, might enhance the use of simulations within and across the military services (e.g., by establishing common standards and platforms or by developing centrally managed simulation facilities that are used by different organizations).

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[9]It may also make sense to expand the adaptation and use of commercially available products in these areas.

[10]Several agencies are now responsible for publishing and transmitting these products, often in paper form.

Appendix

IMPROVING CIVILIAN EDUCATION AND TRAINING

The above research findings and lessons have been developed from research on military (largely Army) training programs. However, insights from these studies can help civilian education and training policymakers address some of the problems that they confront in seeking to improve education and training in the nation today. Here, we offer some thoughts on the potential for such crossover.[1]

Obviously, there are substantial differences between the military and the civilian education and training system. The military is a "closed system" in which employers (units) and educators (schools) belong to the same organization. Military personnel are a select group; nearly all of them have high school diplomas, with most scoring high on aptitude tests for the jobs in which they are trained. They are volunteers with strong motivation to learn and a contractual obligation to remain in their occupations. The civilian world is different, with weaker links between employers and educators and greater variability in educational objectives and student aptitudes and needs. Moreover, where the military's problem is to reduce the costs of training while preserving its effectiveness, the problem in civilian settings is often that of *increasing* effectiveness within available resources.

[1]See also Beth J. Asch, *Military Support for Youth Development: An Exploratory Analysis*, Santa Monica, CA: RAND, MR-497-A/RC, 1994, and Elizabeth H. Ondaatje, *Policy Options for Army Involvement in Youth Development*, Santa Monica, CA: RAND, MR-352-A, 1993, for discussion of this issue.

Despite these differences, there are similarities in some problems faced in civilian education and training for which the military may hold useful lessons. Below, we describe two such issues: fostering the use of educational technology, and strengthening the linkage between school and work.

Fostering the Use of Educational Technology

As pointed out in recent research conducted in RAND's Critical Technologies Institute,[2] educational policymakers seek to encourage greater and more effective use of modern technology in the nation's schools. For example, the 1994 "Goals 2000 Educate America Act" directs the secretary of the U.S. Department of Education to develop a national long-range plan to promote student achievement by using technology in education. Hence, policymakers and researchers, such as those involved in the RAND effort, are seeking to identify principles for guiding the actions of policymakers, educators, and others supporting this objective.

The research discussed in the RAND report provides some guidance for fostering the use of technology in education. As is true for military educators and trainers, civilian educators will need to address issues of cost, efficiency, and effectiveness related to educational technology, since expanding technology ultimately requires the investment of public funds. Military experience and research reinforces the need for an instructional strategy (identifying which technologies will be used, where, when, and for what purposes) and an investment plan (identifying front-end and recurring costs and savings) for justifying expenditures and guiding these decisions. In addition, it is likely that many of the specific lessons about technology will transfer as well (e.g., showing the efficiency and effectiveness of specific technologies). Military experience with specific educational technology (e.g., CD-ROM technology) and its applications (e.g., for drill-and-practice and simulation) can be informative in this respect.

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[2]See Thomas K. Glennan and Arthur Melmed, *Fostering the Use of Educational Technology*, Santa Monica, CA: RAND, MR-682-OSTP/ED, 1996.

Strengthening the Link Between School and Work

Another issue of central concern to civilian educators is the so-called "school-to-work transition." During the past few years, observers of American society have become increasingly concerned about the competitiveness and performance of U.S. businesses and workers. The conventional wisdom asserts that the quality of American firms' products and services is inadequate, economic productivity is not growing sufficiently, and U.S. firms are losing market share in key products and services to foreign competitors. Many point to problems in economic performance as resting largely with providers of education and training, who are seen as falling short in giving graduates the skills they need to perform effectively in the labor force.

In response, public policies and programs are being proposed for improving the work-related education and training of Americans. Some of these attempts to strengthen the linkage between educational preparation and subsequent employment.[3] Various mechanisms have been proposed for easing the transition from school to work, especially among non-college-bound youth. Some involve new academic structures and programs, including "career academies" and "tech-prep" programs. Others seek to combine school and work through cooperative learning or apprenticeship programs involving schools and employers.

Policy initiatives and demonstration projects promoting such concepts are moving ahead. For example, the 1990 amendments to the Perkins Act mandate state "tech-prep" for coordinating education and training from secondary schools to postsecondary community colleges or vocational institutions. Federal agencies are sponsoring demonstrations of apprenticeship programs and partnerships between the public schools and private sector to enrich students' career awareness (e.g., through the Department of Labor's Office of Work-Based Learning and the Department of Education's Office of

[3]See, for example, W. E. Brock, *Youth Apprenticeship, American Style: A Strategy for Expanding School and Career Opportunities*, Washington, D.C.: U.S. Department of Labor, 1990; Commission on the Skills of the American Workforce (CSAW), *America's Choice: High Skills or Low Wages*, Rochester, NY: National Center on Education and the Economy, June 1990; and Secretary's Commission on Achieving Necessary Skills (SCANS), *Identifying and Describing the Skills Required by Work*, Washington, D.C.: Pelavin Associates, September 1990.

Educational Research and Improvement). Private foundations also sponsor initiatives for reforming school-to-work transitions.

Knowledge and experience from military training programs and research can be helpful in guiding such efforts, especially perhaps in postsecondary vocational education. For example, the military experience emphasizes the importance of setting skills standards and developing measures of performance to establish what members of an occupation need to know and determine how well they perform in specific occupations. Indeed, many existing military skill standards, performance measures, and performance-based testing techniques for specific occupations may transfer to civilian settings. In addition, military experience demonstrates the importance of systematically and routinely linking the standards to curriculum and integrating academic and vocational competencies. Thus, principles of the military's instructional design methods might usefully be applied in civilian settings and provide a basis for linking employer requirements to school curricula. Finally, in this case and others (e.g., programs emphasizing the use of technology), the military experience shows the value of conducting systematic, quantitative assessments of education and training innovations to establish their costs and effectiveness.

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